Vol. XX. April, 1901. No. 4.

MUNICIPAL ENGINEERING

A MONTHLY MAGAZINE

DEVOTED TO THE IMPROVEMENT OF CITIES

PAVING, SEWERAGE, WATERWORKS,
STREET LIGHTING, PARKS, STREET CLEANING,
GARBAGE DISPOSAL, PUBLIC SANITATION, BRIDGES.

PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS AND NEW YORK.

FEB 17 1902

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NO ONE SET, however, was found to embrace all the good points of others, and many of the better ones were cumbersome in the extreme. These forms were afterward taken in hand by competent accountants and carefully studied, and, after a thorough sifting and pruning, the best features of all were embodied in The American Water-Works Standard Bookkeeping System.

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Indianapolis, Ind.

Municipal Engineering

VOLUME XX. APRIL, NINETEEN HUNDRED ONE. NUMBER 4.

RATHMINES MUNICIPAL ELECTRICAL PLANT.

By Frank C. Perkins.

It may be of interest to note the details of a recent installation in England for supplying electric energy for light and power as operated by a municipality, as well as indicating modern English practice for generation and distribution of current for limited areas. The Rathmines Municipal Electrical Plant is installed for the three wire direct current system. Mr. G. F. Pilditch is resident engineer, and it is through his courtesy that the following data and the accompanying illustrations are presented.

The central station is located near the town hall on the council's land, and is a brick and stone structure. The present size of the engine and generator room is 37 feet by 48 feet, but provision is made for extension when desired. The boiler room is located parallel to the engine room, and is seen in one of the accompanying illustrations. The three boilers are each 8 feet in diameter, and about 30 feet long. They were built and installed by Robert Taylor & Sons of Marsden, England, and evaporate seven thousand pounds of water per hour. Vicar's mechanical stokers are used, and the boiler pressure is maintained at 160 pounds per square inch. Holden & Brooks injectors are employed, as well as a Green double-ram steam pump. The feed water is maintained at 160 degrees Fahrenheit, and is supplied by a Blake & Knowles single acting pump, driven by a direct current electric motor of the Lundell type. The feed water heater was installed by Spencer of Wednesbury, and the electric motors for operating the mechanical stokers and scrapers of the Green economizer are of Crompton make. The economizer has 96 tubes and as usual is placed between the boilers and the stack.

Small motors are supplied with current in the various sections of the city from 220 volt circuits while motors of over 7-horse power capacity are operated from the 440 volts conductors of the three wire system.

The lighting circuits and present generating plant can supply more than 20,000 lights, while the capacity may be increased to 30,000 lights by the aid of the accumulator plant. The peculiar arrangement of the direct-connected engines and generators may be noted in the accompanying illustration. Instead of placing one generator on each side of the engine and direct connecting, the engine is placed on one end of the common base and the two generators connected together as shown.

The engines are of the Willans triple expansion compound type, the larger engine having nine cylinders and three cranks and driving the multipolar direct current generator at 320 revolutions per minute. These dynamos are of Mather & Platt design and have a capacity of 300 kilowatts, the steam consumption for this combination being a trifle less than 25 pounds per kilowatt-hour. This engine is automatically lubricated, is provided with steam separator, and a jet condenser with a steam driven direct acting pump in the cellar. The vacuum is maintained at 26 inches. A Klein cooling tower is employed having a capacity of 40,000 gallons of water per hour, the water being reduced in temperature 30 degrees Fr., natural draught only being required in the tower. The smaller engine and direct coupled generators have a capacity of 150 kilowatts, and the engine, which is a compound, four cylinder two crank vertical engine, operates the set at a speed of 360 revolutions per minute. The steam pressure under normal working condition being 150 pounds per square inch, the steam consumption of this engine is said to be under 30 pounds per kilowatt hour.

The storage battery plant consists of 274 Tudor cells containing 13 plates each. They are installed in two sets with 49 cells for regulation on each side of the neutral. The accumulators have a total capacity of 800 ampere hours at a 10-hour rate, and with a potential of 500 volts. A Mather & Platt motor-generator is used in connection with the dynamos in charging, the normal and maximum rates of charge being 120 and 150 amperes. The discharge may be from 100 to 200 amperes. A 10-ton crane is shown in the background of the illustration of the engine room, which was taken from a position on the switchboard gallery. The crane was installed by Higginbottom & Mannock of Manchester, England. The switchboard gallery seen in the foreground is 30 feet long and raised several feet above the engine room floor. The switchboard is nearly 20 feet long, and mounted on a base nearly 2 feet above the gallery floor. It consists of three panels, the center panel being equipped with the necessary voltmeters, battery regulators, neutral bar, together with the Booster ammeter and switch, while the two outside panels are supplied with Bus bars, feeder switches, generator ammeters, generator switches and rheostats. The switchboard and instruments and switches were installed by James White of Glasgow, who manufactures the celebrated Lord Kelvin instruments.

The main and feeder cables are triple concentric, paper-insulated, lead-covered cables nearly .5 square inch in cross-section, laid in cast iron underground troughs filled with resin oil and pitch. Nearly 50 miles of cable are in use; those supplying the arc lights, about 100 in number, are $\frac{7}{16}$ single cables, while all the incandescent work is supplied with concentric cable construction. The arc lamps are placed about 200 feet apart, on artistic iron poles about 20 feet high. There are nine lamps in series, about a dozen circuits being used. The cables were installed by the British Insulated Wire Company, and the arc lamps by Verity of London.

BOILER ROOM, RATHMINES MUNICIPAL ELECTRIC PLANT.

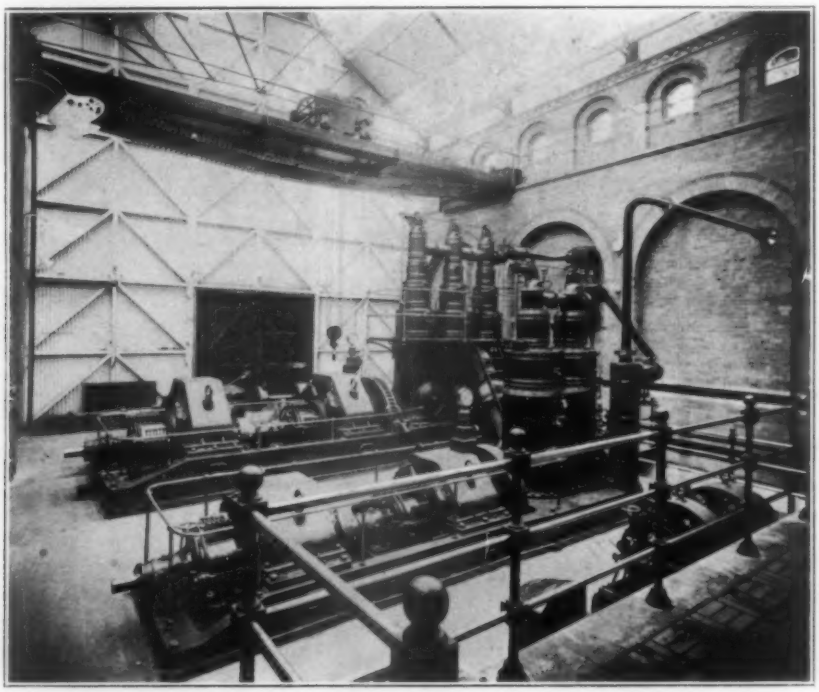
The total cost of the plant is about $400,000, including the central station, lamps, and mains. Several thousand incandescent lamps of 8 candle power are used, this small unit being more extensively used in England than in America.

The rate charged for power and heating current is about 6 cents per kilowatt, while for lighting the rate is 12 cents per kilowatt, 5 per cent. discount from these rates being allowed. Upon application for light the wires and fittings are installed free of expense to the consumer, who pays for the

same by an additional rate of 2 cents per kilowatt being added to his bill. This is known as the free wiring scheme of the National Electric Company of London, and has been recently introduced by the Rathmines electric lighting committee, for the benefit of consumers who do not care to expend the necessary capital to install the wires and fittings on their premises. The entire plant was installed under the supervision of Mr. Robert Hammond, the consulting engineer.

CENTRAL STATION HEATING.

The business of central station heating has passed through its preliminary stages during the past five years and has practically demonstrated the feasibility and the convenience of this method of distributing heat. What may be called the experimental stage has not yet passed entirely and new applications and new economies are being discovered from day to day. From a paper by Wm. H. Bryan, of St. Louis, before the American Society of Heating and Ventilating Engineers, have been selected the quotations upon the general subject of central heating stations which follow, the paper presenting the basis upon which the methods rest their claims for utility and economy very concisely and clearly.

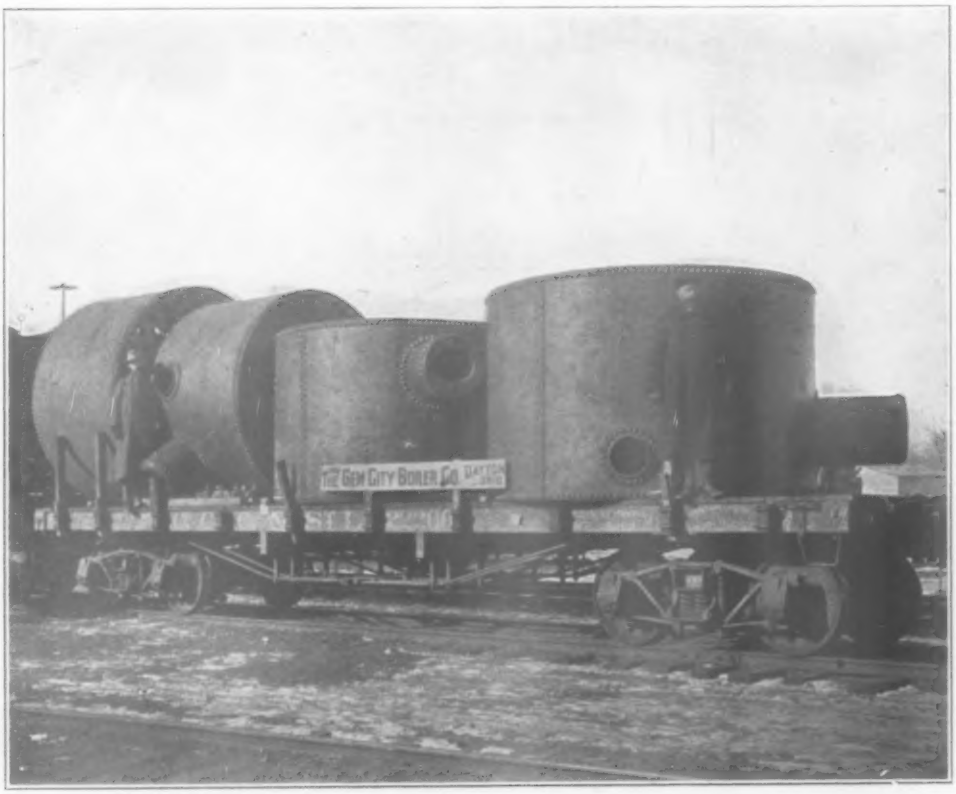


ENGINE ROOM, RATHMINES MUNICIPAL ELECTRIC PLANT.

"Many methods of central station heating have been employed, but they have now been reduced to practically two—steam and hot water. Central station heating follows the same general laws which govern isolated installations. When the sale of steam is the main business of the plant, and there are no engines on which low back pressure must be carried, the steam pressure is high enough to force circulation to extreme distances, and in some cases even to run engines. Pressure reducers are supplied at the point of use to give the customer whatever indoor or secondary pressure he needs. Where part of the steam supply is from the exhaust of engines driving dynamos—as is often the case in modern plants—the pressure must be so low as not to interfere with the proper working of the engines.

This necessitates larger mains, and is sometimes accompanied by difficulty in securing prompt and effective circulation. It does not pay to bring back the returns to the station. The cost of the second pipe, properly insulated, its rapid deterioration, and the frequent presence of oil or other foreign matter, has led to the abandonment of this practice. It is customary to install an economizing coil near the front of the house, over which external air is admitted, giving the necessary indirect heating and ventilation. The returns from the radiators pass through this coil, giving up practically what heat is left in them, and are then trapped to the sewer.

"Hot-water systems are usually operated from central electric plants utilizing their exhaust. This is passed through closed exhaust heaters of large capacity, the outlet being to the atmosphere either direct or through a back-pressure valve. If the heaters are of ample capacity and properly arranged, there need be no back pressure. The water may be given any desired temperature up to 212 degrees Fahrenheit, and is circulated by steam pumps. There is an outgoing and return main, the distribution being what might be called multiple-series. At each building served, a connection is taken from the supply main and serves the radiators, which are themselves in series or multiple-series. The returns are finally collected and go to the return main. There are a few instances of single-pipe mains, the returns going back to the same main, being diverted to the house by a shunt."

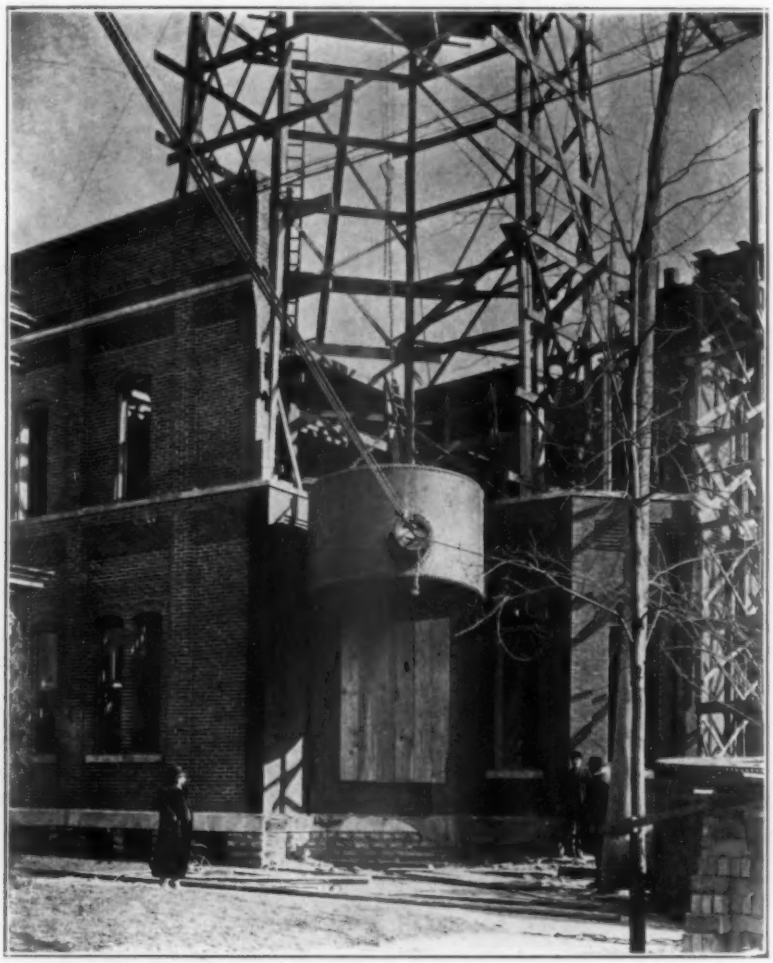


SMEAD'S BOILERS EN ROUTE FOR CENTRAL HEATING STATION AT WASHINGTON COURT HOUSE, OHIO.

A central heating station has just been completed at Washington Court House, Ohio, by the Central Heating Station Company, of Cincinnati, which is designed as a heating station with no provision for the use of the station for other power purposes. The special design of vertical boilers in standpipe form utilizes so large a proportion of the heat from the furnace that the plant is expected to compete successfully with those in which heat is a by-product, or in

which a by-product of electric current can be sold to help in increasing the income. The form of the boilers can be seen in the illustration, showing a car-load of them en route, and in that showing a boiler on its way to position in the stack.

"There are two methods of regulation. In some cases the water is sent out at a constant temperature, and each individual user controls his radiators just as he would his own plant, turning them on and off at will; or he may regulate them automatically by thermostats; or the entire plant may be handled by thermostats. In such an installation the speed of the pump varies, being controlled either automatically by a thermostat, or by an attendant who judges of the heat requirements by the temperature of the return water. In other installations the pump is operated at a fixed speed, the temperature of the water being changed with the weather. By adjusting the radiator valves of such installations the proper amount of water can be kept circulating through them, the customer thus being relieved of all care in the matter of regulation. The station attendant keeps close watch of an external thermometer, and raises or lowers the temperature of the outgoing water to correspond.



ELEVATING TO POSITION A SECTION OF SMEAD'S STAND PIPE BOILERS AT CENTRAL HEATING STATION, WASHINGTON COURT HOUSE, OHIO.

"When the exhaust is insufficient, live steam may be admitted to the heaters, just as it would be turned into the mains with the steam system. In either case, separate boilers may be fired, discharging steam or hot water directly into the mains without

the intervention of engines or heaters, a practice often followed.

"One difficulty arises in that the use of exhaust steam has usually necessitated a considerable back pressure on the engines, thus straining them beyond what they were built for, and reducing both their capacity and efficiency. The situation is improved by separating the exhaust into two mains, and allowing only a portion of the engines to exhaust into the heating mains when the demand for heat is small. The exhaust from the remaining engines then goes direct to the atmosphere, without back pressure, or to the condenser.

"The following points of advantage appear to be with the steam system: 1. Simplicity, there being a single pipe line, and no pumps being necessary. 2. The equipment or plant appears to be more durable. The life of underground pipe lines carrying steam has been shown to be much greater than those carrying hot water. 3. The investment in radiators for utilizing the heating service is less by the usual ratio between steam and hot water radiators. 4. The system will satisfactorily serve buildings which have been equipped for either steam or hot water heating. A hot-water plant can not handle a building equipped for steam heat, except at the expense of reconstruction. 5. Less pressure being carried, there will be fewer leaks, and less liability to damage in case of accident. 6. Leaks may be repaired, valves packed, etc.; without the necessity of shutting off the entire house. 7. The steam people have whatever advantage results from long experience in the heating business, and the construction and operation of many plants under wide ranges of conditions.

"The following advantages appear to be with the hot-water method: 1. Cheapness of installation, although this is to some extent offset by the necessity for a return line. The low temperature makes it unnecessary to provide as many expansion joints, or to use as high a grade of insulating material, while the fact that the medium is water renders sub-drainage unnecessary. 2. Milder

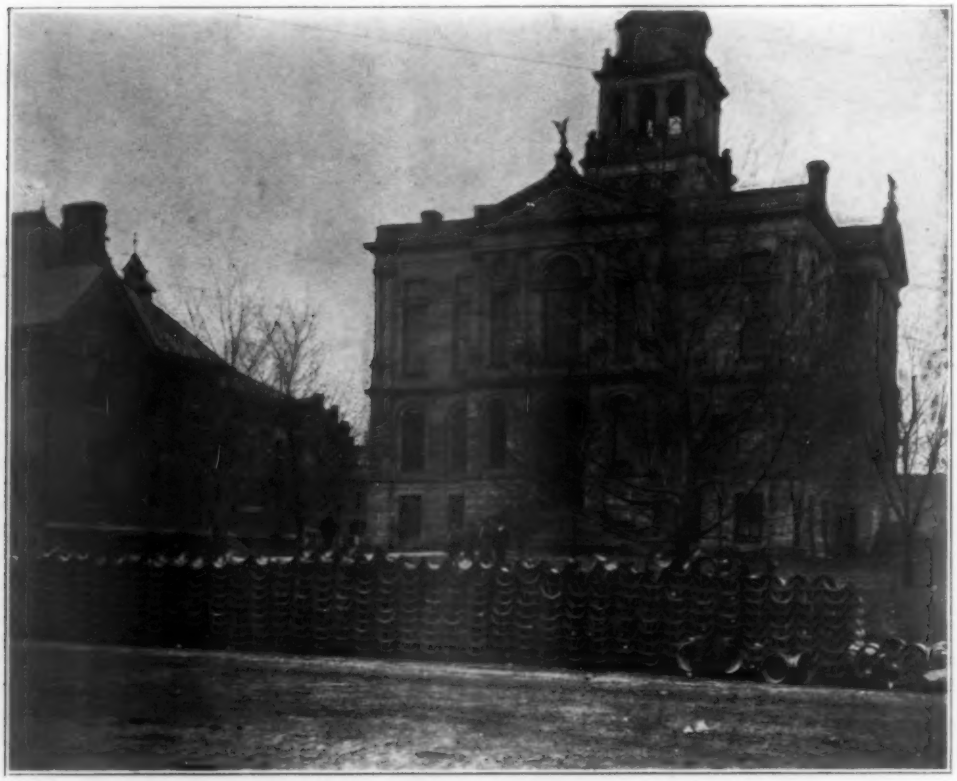
VIEW OF SMEAD CENTRAL HEATING STATION, WASHINGTON COURT HOUSE, OHIO.
Second Story to be Used as Public Library.

temperature, which is preferable in radiators, hot water now being used almost exclusively for residences. The low temperature also reduces the radiation losses, which are proportional to the differences of temperature. 3. There being no waste to sewer, either at low points or at discharge from residences, there is no loss of water or heat at these points. 4. Water appears to adapt itself readily to regulation, either automatically or by an attendant at the station. 5. Water appears to lend itself better to heat storage, which would improve the economy at the station. 6. Operation without back pressure. While this is of less importance than would appear at first glance, it nevertheless should have the earnest attention of the steam advocates. 7. There are no offensive odors from the air valves of stuffing boxes of radiators. 8. It would appear to be easier to discover and locate serious losses of water or heat.

"There appears to be no choice between the two systems in the matter of power required to circulate the heating medium.

"It would appear possible to meter both systems. The use of steam could be measured either directly by steam meters or by hot-water meters on the returns. In those water systems carrying constant temperature and changing the speed of pump to suit the demand, the water could also be metered. This could not be done, however, where the speed of pumping is constant and the temperature is varied.

"The rates charged for heating in different cities and under different conditions vary considerably. The conditions controlling the price are the cost of fuel, the distance the service is carried, range of external temperature, and number of months of service. In most cases the charge is for a season's service, and is based either upon the square feet of radiation, or 1,000 cubic feet of space heated. The rates for hot water vary be-



COURT HOUSE AND JAIL, HEATED FROM CENTRAL STATION, WASHINGTON COURT HOUSE, OHIO, USING SMEAD'S STAND PIPE SYSTEM AND HOT WATER LINES.

tween 12½ cents and 20 cents per square foot of radiation. For steam, the range is from 15 cents to 30 cents, although a rate of 50 cents is reported from Seattle. The charges run from $2.50 to $5 per 1,000 cubic feet of space heated, which, of course, is independent of whether steam or water is used. A slightly higher charge is made for indirect radiation. When steam is sold by meter, the unit is the kal, which is the amount of heat required to evaporate one pound of water. This charge varies from

LAYING HOT WATER LINES FOR SMEAD'S CENTRAL HEATING STATION, WASHINGTON COURT HOUSE, OHIO.

45 cents to 80 cents per thousand kals, depending upon the customer's requirements.

"Experience in hot-water plants indicates an average consumption of coarse slack of about 55 pounds per square foot of radiating surface per season. If we assume that one square foot of surface heats 50 cubic feet, then 1,100 pounds of coal will heat 1,000 cubic feet of space, or with slightly better coal it may be said that one pound per season will heat one cubic foot of space.

"A concise statement of the advantages to the customer, and the general public, resulting from the installation of a central heating plant, may be worth making. The customer saves the expense of coal and ash handling, with their unavoidable accompaniments of dirt, dust, smoke, and soot. The saving of labor is a considerable item, particularly in large plants. The heat supply is regular, continuous, and unlimited, and is available throughout the entire night and on Sundays and holidays. The building need never become cool. The heat is capable of regulation and adjustment with fluctuations in the external temperature. Valuable space in basements and cellars is saved, there being no longer any necessity for boilers or coal storage. It is possible to have a cool cellar, which is often an advantage where it is desired to keep vegetables or provisions. Insurance rates, too, are less where there is no fire in the building.

"The service demanded of the ordinary heating boiler is so variable, and it has so little skilled attention, that its thermal efficiency is very low, rarely exceeding 50 per cent. and averaging probably not over 35 per cent. Furthermore, in order to keep fire over night, and to avoid making a smoke

nuisance, it is almost imperative in many ordinary heating plants to burn the most expensive grade of the very best coal. In large St. Louis residences, for instance, anthracite lump of 13,000 British thermal units per pound, costing $7 to $8 per ton, is burned, with an average efficiency of 35 per cent. Under the boilers of a central heating plant, slack coal or screenings, costing $1 per ton and having a calorific value of 10,000 British thermal units, would be burned, with an average efficiency of 60 per cent. The fuel cost of the isolated plant under such conditions is ten or twelve times as great as that of the central station.

"There are advantages to the general public in central station heating in the concentration of the plant in an out-of-the-way location, in the reduction of the number of coal and ash teams on the streets, and the removal of the smoke nuisance, aside from the direct benefits obtained by those who make connection with the plant.

"There are many incidental advantages connected with the use of central station heating beyond the mere saving of fuel. This service—while in many cases a necessity—is in some instances a luxury, and it should command a price accordingly. It is worth much more to a customer than the mere amount he saves, and he should be willing, therefore, to pay the central station a rate which will enable it to earn a fair return on the necessary investment."

The plant at Washington Court House, Ohio, is designed to be practically smokeless, and one of the great benefits to the public at large is the removal of the cloud of smoke now arising from the many individual stoves and furnaces in the residences and business blocks of the city. Our view of the station during construction does not show the character of its architecture, but the building is quite as ornamental as the usual municipal building. The confidence of the municipal authorities in the cleanliness of the plant, and in its freedom from noise, is shown by the fact that the second story of the plant

LAYING HOT WATER LINES THROUGH "COURT HOUSE ALLEY" TO BUSINESS SECTION, WASHINGTON COURT HOUSE, OHIO, BY THE CENTRAL STATION HEATING CO., CINCINNATI, OHIO.

has been leased for the public library. The central location, in the best residence portion of the city, was another reason for this choice.

A view is shown of the court-house and jail, which are among the larger buildings to be heated from the station. Two views of the trenching for laying pipe lines are also given.

METHODS OF CLEANING PAVEMENTS.

By H. C. Innes, Hartwell, Ohio.

There are several ways in which this cleaning takes place. The first, and recognized by all cities where sheet asphalt is laid as the best means, is termed hand cleaning.

This process consists in the division of a street into sections, each of which is cleaned by one man, who is held personally responsible for the appearance and condition of the pavement in his charge. The amount of surface which one man can sweep is approximately as follows: When the asphalt is wet and muddy he can sweep about 1,000 square yards per hour; when dry, about 1,200 square yards per hour. This is about all one man can take care of, in the down town or business portion, where the travel is somewhat heavy. But in the resident district, where the travel is somewhat light, a man can keep several blocks in a very nice appearance.

In some cities, especially on a retail thoroughfare, the merchants, recognizing the benefits derived from a perfectly clean roadway, engage a man to take care of the block and each firm pays their proportion for the cleaning of the block. This has an effective result, and the cost to each firm during the month is very small, considering the benefit obtained.

Several small implements are necessary for the hand cleaning process, which are quite reasonable and can be procured anywhere. The street scraper is made of a cast-steel blade about four and one-half feet wide, six inches deep and three-eighths of an inch thick, slightly convexed, with a handle attached at the center, about five feet long. This is used principally to collect the mud and manure from the surface into a pile, near the gutter. The operator pushes it ahead of him, and being so thin it easily adjusts itself to the surface of the pavement. Any blacksmith can make this tool and the cost will not exceed $3. Two brooms will be required for sweeping, costing about seventy-five cents, a shovel or a scoop costing eighty-five cents and a wheelbarrow, the cost of which would be about $2. These are all the tools essential for keeping the roadway clean, free from dirt, dust and organic matter, and if the man is active he can keep his section in a very clean and healthy condition.

Early in the morning, when travel is light, each man should sweep a part of his section, to remove the dust which will accumulate. He should get over his section entirely at the end of the third day. The remaining part of the day he goes over hastily, collecting all refuse before it has had time to dry or be ground into dust by passing wheels. By the aid of a scoop he places this waste material into the wheel-barrow, with which he removes it to some adjacent alley and deposits it in bins or tanks supplied for the purpose. Or it could be left in small piles near the gutter, and at regular intervals removed to the city dump by the street wagons. These barrels or tanks could be made tight with a screw top, so as to permit no objectionable odor to escape. Another form for the alley tanks could be made by taking a cask, about the size of a barrel, at the center place an axle, with which the barrel could be lifted and wheeled by a truck made suitable for the purpose. This could be filled and placed in the alley, and would save one handling of the material.

The amount of sweepings taken from the asphalt pavement is not great, and by the above process all could be properly taken care of and quickly removed. In a brief time the man becomes accustomed to the work, and can by little exertion keep his section in a good condition.

The cleaning of our streets by machines is generally done at night time. These machines are all similar in construction, consisting of a platform, various levers and the revolving broom of steel wires or hickory. The broom is set at an angle of about twenty degrees, and as it revolves casts the dirt toward the gutter. The operation of cleaning the streets by machine commences with a sprinkling wagon going over the street at a rapid gait and depositing only enough water to lay the dust. Next come

the great sweepers, two or three of them, the second about 50 feet behind the first, the third the same distance behind the second. They take one-half of the street at a time; when this half is cleaned, the sweepers return, taking the other half.

Following the sweepers is a small force of men with brooms, sweeping the dirt into piles. Then comes the ordinary dump wagon and men who load these piles of dirt into the wagon. When full the wagon takes material to the dump. These street sweepings have a great value as a fertilizer and in many instances are used extensively on farms.

Then there is another class of street sweepers which have a receptacle to receive the dirt as the revolving broom passes the material into this closed apartment. With such a machine there is no need of having a force of men to sweep by hand the dirt into a pile. This machine works almost identically like the other class of sweepers mentioned, with its platform and revolving broom, except that there is added a compartment into which the dirt is placed.

Another class of street sweepers are those which pick up the dirt by suction and place the material into a bin or receptacle, and when filled are dumped at some corner where a wagon receives the sweepings and carries them to the dump. These machines are large and require from three to four horses to pull them. They are provided with an upright boiler and fans which create the vacuum which draws the dirt into the receiver. These machines are best adapted to smooth street surfaces, and are used extensively in Indianapolis, where they are manufactured by the Pneumatic Street Cleaning and Manufacturing Co.

One of the recent applications of the electric car is to equip the car in such a manner that the motive power of the electric line can be utilized. This can be done by placing revolving brooms on the side and front of the car, projected by an arm, and place the sweepings into the gutter, or by suction pick up the dirt and deposit into a receptacle on the car. These cars could clean all the streets over which an electric car line is located, the motive power being much cheaper than horses and the work could be done more quickly.

In many cities the work of cleaning the streets is let by contract at regular lettings. In this event the contractor furnishes all tools, men, teams and machines. Some cities do their own cleaning and have their own outfit. There are many street sweeping machines of various patterns and styles and yet all similar in operation; the cost of all are about the same and all have some very good features. There are defects in almost any good device and the street sweepers are not without some. Yet the results obtained by these machines are good; they keep the thoroughfares clean, and that is a great item to be considered. They are reasonable and every city should have at least one and operate it continually. Really three machines are a set and should be found in every city having paved streets.

The usual hour for commencing this work depends largely upon the number of machines a city or contractor may have and the number of miles of paved streets to sweep. All paved thoroughfares, especially in the "down town" district, should be swept every night. In the truly residence portion the need is not so great to sweep nightly. Usually, however, sweeping does not commence before nine o'clock. Care should be taken when using a sprinkling wagon that too much water does not find its way to the pavement, as the water creates mud and when the broom revolves on the pavement it tends to plaster the mud. Upon drying it becomes dust. Merely enough water should be used so as to "lay the dust" when the machine passes over the street. Should any vehicle be standing in the gutter it should be moved out of the way so that the sweeper can go the full width of the street.

Another way in which we can clean our streets is by flushing them. This is done sometimes by attaching a hose to the fire hydrant, turning on the water and thus cleaning the street. In other words, giving it a good washing. It is not advisable, however, to wait until the street is very dirty because this filth must find its way to the sewer, and there is a chance of stopping the flow in your sewer. The street, before this is attempted, should have all the refuse taken away that is possible to remove. The flushing is merely to remove the fine silt or dust. On an asphalt street such a cleaning two or three times a week is very beneficial. After the flushing your roadway is as clean as it can be had. Another way in which flushing can be done is to have a sprinkling cart pass over the street at a very slow speed, merely moving, and the valves opened wide. The wagon should go over the street up grade. Behind the wagon a man or two could follow with the ordinary street scraper, such as is used for hand cleaning, and scrape the dirt toward the gutter and col-

lect it in piles, which can be removed by a wagon. A good heavy broom should be used also to sweep any dirt which might remain in the gutter.

The most effectual way for flushing is by the hose, but when this can not be done the wagon process does very fairly. Flushing could be done either at night time or early in the morning, so as not to interfere with the travel. By proper cleaning of the streets at regular intervals, the dirt is removed and leaves the roadway in a condition so that at all times it can be crossed by pedestrians without soiling their dresses or muddying their shoes.

Sprinkling an asphalt street is not necessary. The roadway should be dry at all times, if possible, the dirt and dust being removed by sweeping or flushing. In doing this your thoroughfare is passed at all times and at any place. Clean streets are essential to health, and we should look to this and always keep them clean.

We have no other material for a street surface that is so easily cleaned and kept clean as a pavement laid with sheet asphalt. Such a surface requires care, as does anything. If we have an article in our homes that is pretty or which we have a fond feeling for, we most certainly take care of it, using every precaution against its becoming dilapidated or showing signs of ill usage.

An asphalt pavement is the most perfect of any of our streets, from many points of view, and when we have such a street it behooves us to take care of it and to appreciate its beauty.

Refuse or the autumn leaves should not be burned upon it, as the heat tends to soften the pavement and possibly burn the asphalt. Fires should not be made upon it and live coals from the fire engines should not be placed upon its surface. Drivers of coal oil wagons should see that the faucets of their tanks are kept closed tight so as not to permit any of the oil reaching the pavement as they pass, because oil of this kind also tends to soften the pavement. With a little care the drivers could keep oil from dripping to the roadway.

If we exercise a little care and caution in these particulars our asphalt streets will be models of perfection.

COAL TAR FOR PAVING USES.

By Fred. J. Warren, Boston, Mass.

Coal tar is a generic term applied to those bitumens which are extracted from coal by various processes in the manufacture of gas and coke. Commercially the name is improperly applied to water gas tar. The nature of the tar varies as does the nature of the coal, and also varies with the processes employed in the manufacture of the gas or coke. The process of collecting the tar is to pass through a cold water bath all of the vapors produced by distillation and which come off the coal and the other materials used. The gas rises to the top of the water, a large part of the ammonia is carried off in solution in the water and the tar is condensed by the water and settles to the bottom of the water bath.

There is no known method of describing accurately the true condition of tars. It is proper to say that no two tars are identical in every respect, although many tars are identical in every essential respect. Variations also occur from the admixture with the coal in the process of distillation of greater or less quantities of oils of various classes used for the purpose of enriching the gas. The tars vary in the amount of bitumen which they contain within the limits of 60 and 92 per cent. They also vary largely in the percentage of oil which they contain and in the quality of the oil. The non-bituminous matter contained in the tar is generally carbon, which is synonymous with lamp black, and was, of course, hydro-carbon before hydrogen was eliminated by combustion. The carbon is insoluble in carbon bisulphide or in the lighter coal tar oils, while all of the bitumen is soluble in coal tar, benzine or naptha. Petroleum light oils or carbon bisulphide does not furnish a perfect solvent for coal tar bitumen. The process of determining the amount of bitumen in a tar is to liquefy it further by the use of coal tar benzole and all of the solution will pass through the filter paper except the carbon. About 2 per cent. of the carbon is so fine that it will go through the filter paper and will appear by this test as bitumen.

The study of the by-products of tar is a very interesting one, but is too voluminous to be touched upon in an article like this, which has more largely to do with cements or pitches manufactured from tar for use in the making of concretes.

Coal tar cement is a residue by distillation of coal tar. Hardness is produced in coal

tar cements, as in other bituminous substances, by removing part of the oils contained in the bitumen, leaving the residue of the consistency desired. Flexibility is maintained by sacrificing a certain amount of the hardness. To make a cement or pitch of a given consistency, say the equal of asphalt cement at 78 degrees F., or a standard asphalt paving cement, requires the removal in one case of 16 per cent. of the original oil, and in another as high as 52 per cent. The natures of the oils removed vary as greatly as do the natures of the residues left. One per cent. of oil taken from one tar will produce more hardening effect on the residue than will $1\frac{1}{2}$ per cent. taken from another. The quantity of oil removed at any given temperature from various tars varies greatly. Using an inferior tar, a pitch or cement can be produced by distilling off the oil at a temperature of 200 degrees, while using the most permanent tar in practical distillation requires a temperature of about 600 degrees. The temperature at which coal tar cements can be produced can be reduced greatly by supplementing distillation by mechanical agitation or by blowing super-heated steam or hot air into the still. The character of the residue or cement left by distillation depends somewhat upon the process employed, even when dealing with a given tar.

With the above synopsis of what coal tar pitch or cement is, I would say that coal tar was, up to 1845, the waste product of the gas works. The process of making gas at that time was crude, and the coals used were of a more uniform grade than those used at the present time. Tar was first used in its crude state as a supposed adulterant of pine tar pitch, which was then used to a very limited extent for roofing. This use developed that the more coal tar bitumen was used the better was the roofing material. The development from 1845 to 1865 was almost entirely in building composition roofs, and for this purpose it was not realized that any great care was necessary in the selection or preparation of the material. Notwithstanding the imperfect methods adopted, the industry has grown to immense proportions, and the roofing industry furnishes by far the largest market for all of the coal tar products of the country, amounting to over five hundred million pounds per year, and giving employment to about fifty thousand men. It has therefore not seemed necessary to the manufacturers of coal tar goods to adopt any of those methods in the preparation of their cements which have been so essential to the proper use of the asphalt bitumens, when applied to the building of concrete or asphalt pavements.

While vast sums of money have been spent in chemical research on the use of more than two thousand by-products of tar, it is a sad commentary upon the manufacturers of tar cements that there is not one large established concern in the United States which maintains an efficient or modern laboratory, which alone will enable them to put on the market an even approximately uniform bituminous cement. In the sixties an effort was made to imitate the asphalt mastics of Europe by producing an artificial asphalt mixture using the coal tar cements to bind the particles of sand together. It should be borne in mind that all classes of concrete, whether asphalt cement, coal tar cement, or hydraulic cement is used as a binding material, are in fact artificial stones. The durability of the work depends upon the selection of the cement as well as upon the selection of the mineral aggregates, whether sand or stone, and upon the skill and care displayed in mixing and laying. The cement is used to bind the particles of mineral matter together. The skill and experience displayed in the selecting of the cementing material and the selection of the mineral matter has much to do with the durability of the work. Unfortunately, those engaged in the building of tar concrete sidewalks had not given the matter much, if any, scientific consideration, and at the time the tar bitumens were extensively used no one had any accurate knowledge of the proper selection of the mineral aggregates. This condition, combined with the fact that no one engaged in the business carefully prepared the bituminous cements, led to disastrous failures in a very large proportion of all the bituminous concretes put on the market. It should be noted, however, that the same methods, when asphalt was first used, led to almost equally disastrous results.

To what extent the tar bitumens are available for use in concrete structural work the writer is not yet prepared to say, but a few facts can be recorded. There are a few cases which exist to-day which show conclusively that when at their best tar concretes have developed a life greater than the longest life of any piece of asphalt work in this country under any condition of usage. This is because asphalt pavements, or concretes, have not been in use as long as the best tar concretes, but the writer has no doubt but that a properly selected asphalt bituminous cement will under most conditions of usage

develop a greater life than can be developed out of the best coal tar cement under exactly similar usage. Asphalt is as generic a term as coal tar, and the name can be properly given to any natural bitumen of a gummy nature as found in nature, whether it be admixed with mineral matter of various classes, or is found in a relatively pure state. The nature of the bitumen found in the asphalts combined with mineral matter is as various as is the nature of the bitumen found in the tars, and experience and development have demonstrated the necessity of great care in the proper building of asphalt concretes or pavements. When the same methods which are found necessary in the building of asphalt concretes are employed in the selection of the tars and in their preparation, it is possible to produce cements of as great uniformity as it is possible to produce when using the asphalts.

Tar cements as a class have the following advantages over asphalt cements as a class:

1st, greater adhesiveness,

2d, greater waterproofing qualities,

3d, greater ductility.

The best coal-tar cements are inferior to the best asphalt cements in the following qualities:

1st, All of the oils contained in coal-tar cements can be evaporated at relatively lower degrees of temperature, and are, therefore, shorter lived as affected by the sun.

2d, The best coal-tar cement contains a shorter range of flexibility under atmospheric conditions than does the best asphalt cement.

While the above is true of the coal tars as a class, it is equally true that the best quality of tar can produce a cement for certain classes of concrete uses which is superior to the average grade of natural asphalt cement, and this is especially true as applied to the building of bituminous concrete sidewalks and of bituminous macadamized roads. In sidewalk work the writer knows of one piece of pavement which has been in satisfactory use for over forty-two years, the bituminous material of which is coal-tar bitumen, and he knows several isolated cases where the sidewalk has been in use for twenty-five years.

Coal tar will never displace the use of asphalt, for any advancement which takes place in the use of coal tar will also take place in the use of asphalt. The coal tars under a proper system of development are bound to furnish to the trade the cheapest cement available, and one which, if carefully handled, will produce concretes suitable for many uses, and which will last from twenty to thirty years. It will produce the cheapest good concrete which can be produced, but it is not possible of development to such an extent that it will produce a mastic which will stand intact for centuries. This is true of the asphalts, specimens of which are recorded as being found in the ruins of Babylon and the Tower of Babel twenty centuries after their construction.

The modern method of examining the bituminous material is to collect specimens of concrete which have shown long life, extract the bituminous matter and determine the percentage of bitumen and the temper as recorded by penetration machine and then separate the mineral aggregate into the various sizes of material. By carefully noting the conditions which exist in each specimen examined, and by examining a large number of specimens, a reasonably accurate conclusion can be drawn by a man of sufficient experience to enable him, with reasonable certainty, to duplicate the condition which he finds invariably exists in those particular specimens which have developed the greatest life.

A careful examination of the oils produced by distillation shows a relatively greater difference in their physical and chemical characteristics. An examination of the residues produced with a view to developing their physical characteristics develops fully as great differences in the quality of the residues as exists in the quality, quantity and amount of volatile matter of the oils. But the writer would prefer to touch on the physical differences of the cements at another time.

AMERICAN PORTLAND CEMENTS.*

By S. B. Newberry, Sandusky, Ohio.

I esteem it a great privilege to come before you to present the claims of one of America's new and great industries, and one which in the last ten years has developed at a more rapid rate than any other branch of manufacture. Ten years ago

*A paper read before the Indiana Engineers' Society, 1901.

American Portland cement was practically unknown, and nearly nine-tenths of the Portland cement used was imported from Europe. To-day the consumption of this material has increased more than four-fold, and more than 75 per cent. of the total, over 7,500,000 barrels yearly, is the product of American mills. Portland cement is now made at fifty factories in this country, representing an invested capital of over twenty million dollars, and the value of the annual product is not less than ten million dollars.

An industry which has developed in ten years from a production of 400,000 to 7,500,000 barrels is certainly a healthy and substantial one, and a brief study of the manner in which American engineers have solved the chemical and mechanical problems of adapting this branch of manufacture to American conditions can not fail to be of interest.

Portland cement derives its name from the resemblance in color of the hardened cement to the Portland stone, quarried in England. It is, therefore, a name which represents a *quality*, not a locality. The same material may be made in any country in the world, provided deposits of carbonate of lime (limestone or marl) and a suitable clay are available. In England, chalk and clay have been used for Portland cement manufacture since 1828. Later, the Germans established the industry, using limestone, marl and clay, and took such pains with the process that they greatly improved the product, and German Portland cement became the standard all over the world. Attempts to produce Portland cement in this country were made in 1873 near Kalamazoo, Mich.; the first successful efforts were those of the late Mr. D. O. Saylor, at Coplay, Pa., in 1878. In the latter vicinity occur inexhaustible deposits of clay limestone, approaching a correct cement mixture in composition, and this region has become the chief seat of the industry in the United States.

Now, a few words on the materials and process, in order that the difference between American and European practice may be understood.

Portland cement is made by calcining at a nearly white heat an intimate mixture of carbonate of lime and suitable clay, in exactly correct proportions, and grinding the resulting clinker to powder. The carbonate of lime may be chalk, limestone or marl. Limestone, unless it already contains nearly the amount of clay required, is an unfavorable material, owing to the high cost of grinding to the great fineness necessary to secure a perfect mixture with the clay. Even in the case of the clay limestone found in the Lehigh Valley region, the different strata must be selected and ground together in such proportion as to yield a mixture varying not more than one-half per cent. from the correct standard.

In Europe, the burning has been done in vertical intermittent or continuous kilns, similar to lime-kilns, and this method was originally used in the United States. The use of these kilns necessitates molding and drying the raw mixture in the form of bricks, before burning, an operation which involves much handling and greatly increases the cost of the process. In 1885, Ransome, in England, patented a revolving kiln, fired by gas, into which the cement mixture was to be fed continuously in the form of powder at the upper end, and discharged at the lower end in the form of clinker. Ransome's kiln was a very small one; the results obtained were not satisfactory, and the experiment was soon abandoned. Perceiving the possibilities of the new kiln in saving of labor, and its consequent especial value in the United States, Mr. Navarro, of New York, began in 1888 to manufacture cement at Coplay, Pa., by the Ransome process. Many difficulties were encountered and a large amount of capital was expended, but success was finally attained, especially after the substitution of crude oil for gas as fuel. About the same time, Mr. Duryee, at Montezuma, N. Y., and the Warner's Cement Company, near Syracuse, made the further advance of introducing the raw material in the form of wet slurry at the upper end of the kiln.

As the rotary process became better understood it was found that the short burning and quick cooling yields a much better cement than that obtained from the old-fashioned kilns. The use of the rotary kiln rapidly extended, and at present over 80 per cent. of the American product is burned in this apparatus. The advance in price of crude oil necessitated the use of some other fuel, and coal, ground to fine powder, and blown into the kiln by a blast of air, was found to be an effective substitute.

The accompanying diagram shows the production, importation and total consumption of Portland cement in the United States from 1890 to 1900. You will note that the production has increased nearly twenty-fold, while the imports have remained nearly constant. The total amount of Portland cement consumed, the sum of the domestic

product and the imports, has increased fourfold since 1890. In 1891, 13.2 per cent. of the cement used was American manufacture; in 1896, 35 per cent.; in 1898, 65 per cent.; in 1899, 74 per cent., and in 1900, nearly 80 per cent.

The points which appear most strikingly in the diagram are:

1. The wonderful growth of the manufacture of Portland cement in this country.

2. The surprising increase in the use of Portland cement, showing how rapidly it is

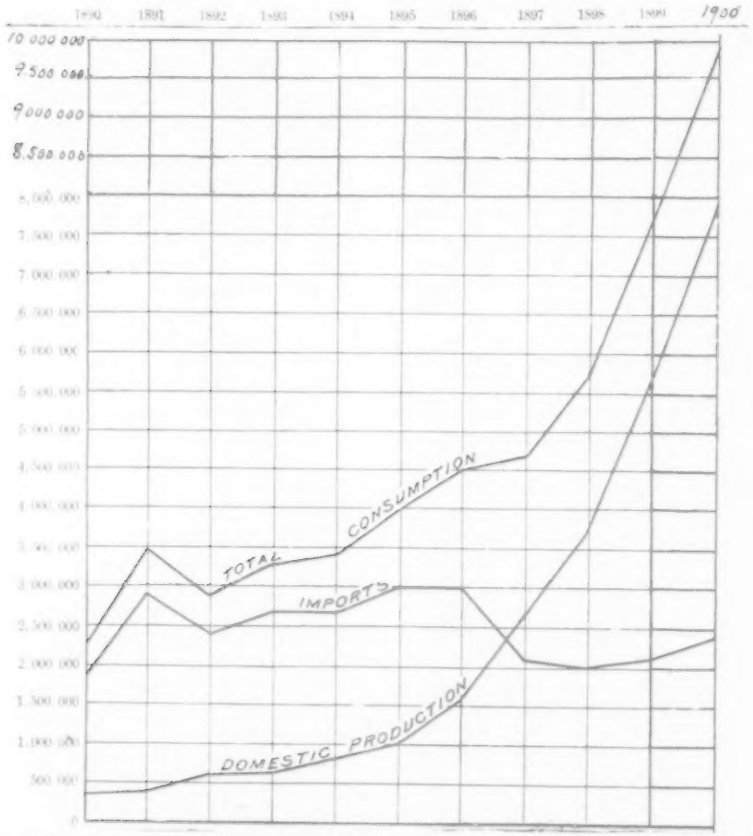


FIG. 1.—Graphic representation of the production, importation, and total consumption of Portland cement in the United States from 1890.

being adopted in place of masonry or the natural hydraulic cements.

3. The nearly constant imports, showing either that the domestic product has been insufficient to supply the demand, or that a certain class of consumers still have a prejudice in favor of imported brands.

The chief cause of the rapid growth of the Portland cement industry in the United States is undoubtedly the development of the rotary kiln process of burning. The old method of burning in vertical kilns involves the molding of the raw material into bricks, placing on wagons, drying in tunnels and charging into the kiln with alternate layers of coal or coke. These operations involve a large amount of labor and a considerable cost for fuel in drying. In the rotary process, on the other hand, the material is introduced into the kiln at the upper end in the form of dust or liquid slurry, and issues from the kiln continuously as burned clinker. The expense of drying, charging and emptying the kiln is therefore entirely saved.

Again, the output of the old-fashioned kilns is very small; that of the intermittent kiln does not exceed 90 barrels every five days, and that of the continuous vertical kiln 80 barrels per day. By the rotary process a regular output of 150 to 175 barrels per day is obtained. Further, the first cost of a rotary plant for a given output is not more than one-half that of a plant

equipped with the old-fashioned kilns. It will be readily seen, therefore, that the rotary process is especially adapted to American conditions, on account of the high cost of labor in this country.

Another cause of progress in the industry in the United States is the widespread occurrence of deposits of excellent cement material. As already stated, inexhaustible beds of clay limestone occur in the Lehigh Valley region; and in the central portion of the country large deposits of marl and suitable clay are found.

In respect to quality, the product of the rotary kilns is certainly superior to that obtained by the old process. It is found that the quick burning and quick cooling of the rotary process, and also the far less contamination by ashes of the fuel, result in the production of cement of remarkable hardening properties, while the long and uncertain burning of the old-fashioned kilns destroys these properties to a considerable extent. In the old process a large portion of the clinker obtained falls to dust in cooling, and this dust has practically no hydraulic properties; the clinker contains much over and under burned material, and must be sorted by hand or an inferior product will result. The rotary clinker, on the other hand, is uniformly burned and free from inert material of any kind.

As to the quality of the Portland cement produced at the leading American factories, I may say that tensile strengths of 600 pounds in seven days and 800 pounds in twenty-eight days, and with three parts sand, 250 pounds in seven days and 300 pounds in twenty-eight days, are the rule. Our leading manufacturers can safely guarantee these results, which are far higher than those yielded by the best brands of imported Portland cement. The German official requirements call for 227 pounds, with three parts sand, in twenty-eight days. Many of the best German cements sent to this country will fall short of this figure.

American Portland cements have been criticised by some engineers on account of the extremely high neat tests shown at short periods. I have, however, found this quality characteristic of all cements made from extremely finely-ground raw material, and quickly burned and cooled. Although our best cements may gain nearly their maximum strength at twenty-eight days, and may show comparatively little increase thereafter, the sand test will be found to show a steady gain for several years.

Another safe-guard of the best American Portland cements is to be found in the regular use of the *boiling test* by our manufacturers. This test has been declared too severe by the German Association of Portland Cement Manufacturers, and is not recognized in the German official requirements.

Still another advantage in the use of American Portland cement is the readiness of the leading American manufacturers to give substantial guarantees of all work done with their product under the supervision of a competent engineer. Such guarantees can not, of course, be obtained in the case of imported cements.

Those who doubt my statement that the leading American Portland cements show much higher tests than the imported, need only to consult the reports of the mayor of Philadelphia for 1896-97. These reports contain the results obtained by Mr. Richard L. Humphrey, inspector of cements, and show the average strengths obtained with all American, German, English and Belgian cements tested in each year. Graphic tables are given, showing that the average of the American cements, both neat and with sand, is far higher than those obtained with the foreign cements. These tests, and many others made by unprejudiced engineers, warrant the statement that there is, at present, no Portland cement made anywhere in the world which is equal in quality to the product of the leading American factories.

Profiting by the success of American engineers in perfecting the rotary process, foreign manufacturers are now rapidly introducing this method into Europe. Rotary kilns have within the past two years been installed in England, France and Germany, and are operating with great success. The report of the German Cement Makers' Association for 1900 states that at Hemmoor, in Germany, the cement obtained was of higher quality than that yielded by the vertical kilns, and that a saving in cost amounting to eleven cents per barrel had already been attained.

EDITORIAL COMMENT.

American Cement Manufacture

The study of the methods of manufacture of cement now in use in America and under process of development, demonstrates again the adaptability of the mechanical engineers of this country and their ability to develop what are practically new methods from hints supplied by others, and to invent new processes for special application under the mechanical, social and financial conditions here. Thus the Ransome rotary kiln was a failure in England for cement work, but American engineers, seeing the possibility of success, expended a large amount of money and time in experimenting, breaking away from established methods whenever it seemed desirable, without fear of consequences. The result is a practical revolution in the methods of Portland cement manufacture, and the advance of America to the fore-front in quality of product, in cheapness, and within a very few years more, in quantity manufactured.

The rotary kiln is now being introduced in Germany with equal success, and material reduction in cost of manufacture. It is under experiment in England but on such conservative lines that its success is not yet fully assured.

A number of grinding machines have been developed for various purposes in this country. Their manufacturers in looking for business find that the cement factories have large use for machines which will grind hard material to a uniform and extreme fineness. They immediately proceed to adapt their machines to this material and enter into successful competition with the stone mill borrowed from the flour mill, and with the mills invented especially for the grinding of cement. The Griffin and Kent mills, the Narod pulverizer, are American inventions which make any desired fineness of product capable of attainment.

In the preparation of the "Directory of American Cement Industries and Hand-Book for Cement Users," it has been most interesting to observe this promptness of the American manufacturer and business man to take hold of a new idea, to develop a new field. A suggestion to a manufacturer that he has machinery or apparatus which can be used in the cement mills which are now springing up so rapidly, or to replace older machines in established plants, sets him to studying the new processes and to demonstrating the adaptation of his particular machine to the work required. It takes but little encouragement to start him to rebuilding a machine to make it fit exactly the new conditions.

A warning note must be sounded in the midst of this rapid development, one which will probably not be heard in the hurry of the advance, but one which is already too late for some who have failed to study all the details carefully before investing their capital. This warning is not at this time against the rapid multiplication of cement plants, though this is marvelous, for the rapidity of development in the use of cement is even more rapid than the increase in manufacturing capacity, and as the price of good cement is reduced by the competition of the many makers, the use of cement will increase still more rapidly, so that the prospect of a glut of the market is at present very remote. The warning is rather against haste in deciding upon a material newly discovered and the construction of a plant where the supply of material is limited or its quality has been misjudged. Under former conditions, and to a large extent under present conditions, such an error could be corrected, for proper materials could be sought for and found, and then shipped at some additional expense to the mill already constructed, the extra cost reducing the profits but slightly. In the future, however, when the question of profits will depend upon the economy of the manufacturing operations, this extra transportation charge, with the attendant items, may make the difference between some profit and none, or a positive loss. This exercise of poor judgment, or rather exercise of judgment upon insufficient data, on account of too rapid survey of the prospects, has been observed in some cases. Formerly, with small and comparatively cheap plants, they could be removed without serious difficulty, but the modern competition demands a plant with a capacity of several hundred barrels a day, one that is practically immovable.

The directory will be ready for delivery in April, and will show what plants are now ready for work, with most of those which will begin manufacture during 1901, giving sufficient description of practically all of them to show their size and facilities for turning out a good and uniform product. This is possible because the managers of the plants have seen the advantage of the appearance of this information in such a book as is under preparation, and very few have refused the information desired, from motives of business caution or otherwise. With the chapters on the development of the cement industry (introductory), on the uses of cement and on descriptions of works, and the directory of companies with their officers, sales agents, and brands, the infor-

mation upon the present state of the Portland cement industry in this country is practically complete. Nor is natural hydraulic cement neglected, the principal manufacturers being well represented, though no serious attempt to list every factory in existence has been made.

Standard Specifications for Brick Pavements.

The National Brick Manufacturers' Association has long had a standard system of tests for paving brick and has adopted programs for such tests, which are now again under consideration by its committee. This committee states that it will not be ready with the report proposing some modifications of the present requirements until June, 1901.

The related question as to the proper method of construction of brick streets has also interested the association, and its committee upon this subject has just made a report, the text of which will be found on another page in this number. It will be seen that the committee makes very few recommendations, and that the various uses to which brick pavements are put have their effect in varying the construction proposed. For cities with heavier traffic the construction proposed will secure the best brick street possible under usual conditions. The modifications proposed for small towns and for country roads are in the line of cheaper construction, which, under the comparatively easy conditions of such towns and roads will secure satisfactory pavements at a cost which will permit the construction of many miles of pavement out of reach of the residence property owners of small cities and towns, if first-class construction were insisted upon.

A very important part of the specifications for a brick street lies between the fields of the two committees. The joint committee of the N. B. M. A. and the A. S. M. I. should, however, consider it and include it in any recommendations of forms of specification. This is the standard of quality of brick for given duty. The committee on tests proposes a program of tests but is careful not to say how the results of these tests shall be applied in accepting or rejecting brick for a given street. The committee on construction suggests general requirements for the process of building streets, and is also careful not to say anything about the quality of brick to be used.

In a general view, the quality of brick seems to be of first importance, but practically the character of foundation is first, as the kinds of brick to be used are in practice limited to hard-burned brick made from certain kinds of clay or shale. Quality is a close second, in any event, and standards of quality can not be omitted from a standard specification.

The fixing of standards for various duties to which brick are subject is even more difficult than the fixing of standard methods of construction, in which the committee is so diffident, for the quality of brick to be used with true economy depends upon the same conditions as the method of construction, and also upon methods of construction adopted. It is, therefore, practically impossible to fix absolute rules for quality of brick, and any recommendations would doubtless be as indefinite as those of the present committee report. If they are equally valuable, however, they will be a safe guide to the inexperienced engineer and municipal official, and will materially raise the standard of construction, especially in the smaller places.

It is comparatively easy to fix the standards for the highest quality of construction and material, but such construction is only necessary in cities of such size that enough expert aid can be secured to make the specifications adequate. What the joint committee needs to do in particular is to formulate a series of recommendations for the cheaper grades of construction economically necessary under the conditions in small cities, towns or villages and country districts. The ordinary councilman or trustee having these matters in charge is not able to fix upon the construction which true economy demands in his case. He knows that his constituents can not afford the best construction, and he has no guide but some hazy notions of cheaper constructions obtained from observation or from reports usually of interested or biased persons, seldom with expert knowledge. While the committee can not solve in advance all the problems arising for all the councilmen, it can lay down some economic principles upon which the selection of quality of brick and method of construction of pavement should be based, and thus help them to better solutions of their problems than they are now able to make. If it succeeds by its report in convincing a councilman that he needs expert assistance in solving his particular problem it has fully justified its appointment.

The membership of the committees, so far as known, guarantees a conservative report which will be in accord with the best practice and will pay proper attention to

the economic side of the question, a most important element in all successful plans for engineering work.

State Supervision of Municipal Accounts.

In 1896, the Province of Ontario created the office of provincial municipal auditor, whose duty it is to examine the account books of any public official, to make recommendations of changes in methods which are desirable, and to report to the proper authorities deficits, errors and other results of such examinations. The report of the office for the year 1900 is at hand, and demonstrates the value of the office. In this one year about $6,000 has been saved to the municipalities whose books have been examined, poor methods of bookkeeping, and possibly in some cases a little dishonesty, havign been responsible for deficits amounting to this sum, which would not have been discovered but for the official examination. These amounts were recovered, being paid without question by the treasurers involved. The books of 122 public offices were examined during the year. Many peculiar methods of keeping accounts and taking care of money are reported. The office does not seem to have power to enforce its recommendations directly, but the regular channels for taking care of deficits are open, and public opinion can be depended upon to improve methods which are not adequate to the business done, when they are reported upon officially.

The effect of the office upon municipal accountants is shown by the statement that in 1897 the department discovered losses of about $100,000 which were not recovered, in 1898 about $11,000, in 1899 about $4,000, and in 1900 nothing, all reported deficits having been made good.

This is an object lesson which should have its effect in aiding the movement toward uniform municipal accounting and the project for state supervision of accounts which is taking a prominent position in the discussion.

New York State Canals.

The report of Mr. Edward A. Bond, New York state engineer, on the proposed barge canal from the Hudson river to the Great Lakes, made to the governor February 12, has just been issued. It was made in obedience to an act passed in April, 1900, and with the assistance of many engineers familiar with the former work on the canals and with the work of the deep water-ways commission of the United States government, and with the advice of an advisory board composed of the most eminent engineers in the country in this class of work. The exact program for the investigation was laid down in the act, and is followed almost without exception.

While the report may be subject to some criticism from the shortness of the time allowed for the investigation, this objection has less effect than it would if there had not been so many exhaustive studies of many of the parts of the problem, the results of which need only to be combined to furnish almost complete data for the present report.

The several alternative routes are divided into convenient sections, varying from 0.65 mile to 71 miles, each of which is carefully estimated. These sections are then combined to form the various routes. Additions are made for extra expense if the work is all done in winter, and deductions are made for abandoned lands to be sold. The resulting routes for the main canal from Troy to Buffalo vary in cost from $46,765,755, via Oswego and Olcott, to $81,578,854, via the present canal route, with some modifications. With the cost of the proposed improvements of the Oswego and the Champlain canals added, the latter figure becomes $87,317,570. This is $25,000,000 more than the estimate made by the committee on canals appointed by Governor Roosevelt in 1899. The increase is due to an increase in proposed dimensions of the Erie canal, increases in estimates of quantities of work to be done on account of more detailed information now available, necessary additional water supply, and other items due to the more hurried report of the former commission and its lack of reliable data on which to base estimates.

A report made by Mr. Bond on February 20, at the request of Governor Odell, submits estimates made by the division engineers on the Erie canal of the amounts necessary to complete the famous $9,000,000 canal, which was left partly done when that sum was exhausted. These estimates amount to $14,973,323 for the Erie canal proper, and $19,797,828 for the Erie, Champlain and Oswego canals, or more than twice the amount already spent. Some opinions are also presented tending to show the limitations of the canal, if completed on these plans, and the probable economy of the larger canal now proposed.

The decisions of the legislature and of the people upon these questions will be awaited with interest. The problems are large, and the new water-way will probably have considerable influence over transporta-

tion conditions throughout the country, no matter which is selected, though there are many indications that the smaller canal will have comparatively small effect. Success here would increase the feeling in favor of extending the Chicago drainage canal for navigation purposes, and would give rise to many similar projects. Failure would probably settle the question of artificial water-ways for an indefinite period. What New York or the United States government spends here will not be quite thrown away, therefore, even if the expectations of the promoters of the large canal are not fulfilled.

ANSWERS TO QUESTIONS.

RELATION OF METER AND FLAT RATES.

Replying to your correspondent from Kaslo, B. C., in your March number, regarding the introduction of water meters in his town and the comparison of the old flat and fixture rates with the meter rate about to be established, I would say that it has come under my observation that all former rates should be eliminated in justice to the small consumer. He is the one who, as a rule, makes most complaint, and it is seldom he does so without a good reason, but he is seldom thought of until he comes to pay his bill, and then he is told he is getting "fair treatment," much to his surprise.

If your correspondent has a large number of small consumers, which I presume he has, their wants should be taken as a basis for establishing a meter rate. In looking over some notes made recently in regard to the consumption of water in various lines of business, I find that without exception they all come under what is called the "minimum rate," which amounts to 20,800 gallons per year. This includes blacksmith shops, barber shops, small bakeries, butcher shops, and so on down the list. The average family of five persons, with bath tub, closet, wash tubs, kitchen boiler, and in some cases a small garden, all come under this rate, and all are satisfied with the amount of their water bills.

To charge all of the separate classes of consumers a different rate would lead to a vast amount of figuring when the time came to render the bills, and when the expenses were figured it would show a balance on the wrong side of the ledger; consequently, for this reason alone, it would not be advisable to establish a meter rate similar to the old flat rates, when the differences are what it is really necessary to be entirely rid of in order to make the department a success.

The consumption of water by the manufactories is not to be lightly considered. If they were only charged a slight advance on the actual cost of the water it would be an advantage to have their patronage in a great many ways.

The establishment of a low meter rate with a minimum rate will develop results that will possibly surprise your correspondent, and I would advise him not to consider the old flat rates as a basis of the new meter rates.

Benjamin L. Williams, Jr.,
West Orange, N. J.

CONCRETE PIPE AND ARCHES.

Can you refer me to any articles, or give me any information on concrete pipe and its use for water and sewers; also any books on Melan arch or similar construction?

R. W. Farley,
City Engineer, Hull, P. Q.

A concrete sewer on piles is described by Eugene Lentilhon in the Transactions of the American Society of Civil Engineers for June, 1894. The details of the Ransome system can be obtained by addressing Ransome and Smith, 19 Ninth street, Brooklyn, N. Y. Latham, Adams and Folwell give more or less upon the subject in their books upon "Sewerage." The specifications for cement sewer pipe in use in Brooklyn can be obtained from the department of public works, superintendent of sewers. "The Directory of American Cement Industries" contains full specifications for Melan arch construction, and for most other uses of concrete. It will be ready for delivery in April. The Melan arch bridges in Indianapolis are described in MUNICIPAL ENGINEERING for February, 1901.

SINGLE-RING BRICK SEWERS.

Will you kindly inform me how large it is safe to build single-ring brick sewers, giving instances where they have been built? *H. M. M.*

The usual practice is to build sewers with a single ring if circular up to a diameter of three feet, if the soil is good. In bad ground two rings should be used, even for the smaller sizes. Single-ring sewers can not

be made certainly water tight, and where leakage from or into the sewer is objectionable double rings should be used. Sewers have been built with single ring in good ground, of five feet diameter, with fair success, but they do not withstand wear satisfactorily and require thorough repair or reconstruction in a few years, whereas double or triple-ring sewers would last indefinitely. South Bend, Ind., has such a sewer.

COST OF STREET CLEANING.

We wish information on the cost of street cleaning. Have you published a tabulated statement for various kinds of pavement in the principal cities of the United States?

Home Construction Company,
Lexington, Ky.

On page 384, June, 1899, a number of statements of prices at which work was let in various cities are given for both street cleaning and sprinkling. On page 201, March, 1900, is a table prepared by Andrew Rosewater, M. Am. Soc. C. E., city engineer of Omaha, giving the total cost of street cleaning, the average cost per mile and the scale of wages paid in forty American cities for 1898, and the estimated cost for 1899. An editorial discussion appears on page 254, April, 1900. Under the heading of "Garbage Disposal, Street Cleaning and Sprinkling," in the department of "Improvement and Contracting News," will be found from month to month the statements of prices at which contracts are let for the next season's work.

BRICK GUTTERS, CROSSINGS AND PAVING.

I would like to have some information about putting down brick gutters and brick crossings; also about brick paving.

The paper on "Modern Brick Pavement Construction," in this number, gives good modern practice in laying such pavements. While the construction recommended is that which will give the best satisfaction, it is true that a cheaper pavement is more satisfactory than none, and some pavements which give good results under light travel have been laid with well compacted gravel foundation or even with two courses of brick. A well drained subsoil of firm materials greatly aids in cheapening the construction of pavements.

The method of putting in the foundation for the concrete curb and gutter, recommended in the paper, is equally good for a brick gutter. If the remainder of the street is entirely unimproved, the gravel or stone foundation should be somewhat wider than the brick gutter and rise to the surface outside to prevent cutting down the gutter by heavy wheels when the street is very muddy. For macadam or other improved street the construction proposed is sufficient.

For street crossings a similar construction can be made, but the depth of foundation should be twelve inches or more, a heavy crown should be given to the crossing, the foundation should be carried outside the brick, and the brick itself should extend somewhat beyond the line within which the crossing is to be kept clean. This is so that in time of deep mud the heavy teams can mount the crossing without striking the edge of the brick paving, with the consequent breakage and dislocation of pavement. If the street is well macadamized or otherwise improved this extension of the foundation is not so necessary.

OIL FOR LAYING DUST.

We are very much bothered with dust, and as water is a scarce article and constant sprinkling is necessary, the question of using oil is under consideration. We would appreciate any information on the subject of how much is required for a certain area, how often it is necessary to sprinkle, and the features that are objectionable. Our oil will cost us about 4½ cents a gallon.

Alamogordo Improvement Company,
Alamogordo, N. M.

A good article on the use of oil for roads will be found in MUNICIPAL ENGINEERING MAGAZINE for January, 1901. A report on the use of oil strictly for laying dust will be found in this number. It was made by A. E. Brock, trustee of the city of Redlands, Cal. Further information will be found in the number for July, 1900, and the report of an unsuccessful experiment by the Massachusetts highway commission on page 332 of the number for May, 1900.

WATER REQUIRED FOR LAYING MACADAM PAVEMENT AND CEMENT WALKS.

What is the average quantity of water required in the construction of a square yard of macadam pavement, and what in the construction of a square yard of cement walks? ——, *Windsor, Ont.*

The character of the specification determines the amount of water required for a macadam pavement. It may range from say that required for cement walks to four or five times this amount. Many macadam pavements have been successfully laid without the use of water.

Computing a cement walk at four inches depth, and using the theoretical proportions of water in the mortar, including the amount necessary for wetting stone, the use of water may easily reach 30 gallons a square yard. This allows a little for excess of moisture. Any water used in moistening the foundation for packing it under roller

or tamper should be added to this. The amount used in practice may be somewhat more than this on account of waste and water used for washing and cleaning boards and tools, etc.

DATA ON ELECTRIC LIGHT PLANTS.

Where can I find data on the ownership and operation of municipal electric incandescent lighting plants where they sell current to the public, and the rates charged?

E. S. Harlow, Washington, D. C.

The recent report by Carroll D. Wright, United States commissioner of labor, is the fullest and most reliable collection of such data. The plants are anonymous in the report, but the data, so far as the question is concerned, are perhaps just as valuable. Regarding street lighting, a summary of this report appears in the report of the proceedings of the 1900 meeting of the American Society of Municipal Improvements. There is also a valuable report in the same line in the proceedings for 1899. D. L. Fulton, secretary, Allegheny, Pa.

MUNICIPAL MATTERS IN COURT.

Prepared for MUNICIPAL ENGINEERING MAGAZINE by Andrews & Murdoch.

Validity of Bid for Paving.—A bid for a street-paving contract was not invalid because the price bid was written over an erasure without any note being made of such erasure, where the bidder made affidavit that the erasure was made before the bid was verified or submitted. In re Clamp et al., 68 N. Y. Supp. 345.

Building Line.—Where a building line on a certain street was established by a common council under authority of the charter, and no appeal was taken therefrom by any of the property owners, but the same was recognized by the inhabitants as valid for ten years, a presumption arises that the line was properly established. State, ex rel. Berger, v. Hurley et al., 48 At. Rep. (Conn.) 215.

Step in Sidewalk.—The building by a city of a sidewalk with a step which, from the nature of the grade, the city government deems necessary and proper, is not such negligence as will warrant a recovery against the city by one injured in a fall caused by the step, unless the plan of construction adopted was manifestly unsafe. Teager v. City of Flemingsburg, 60 S. W. Rep. (Ky.) 718.

Removal of Snow and Ice from Sidewalks.—Where a city ordinance requires that all snow and ice shall be removed from sidewalks within four hours after falling, such ordinance presupposes the duty of the city to keep the sidewalks in a reasonably safe condition for public travel; and a neglect of that duty, resulting in injury to an individual, carries with it a right of action. O'Hara v. City of Brooklyn, 68 N. Y. Supp. 210.

Diversion from Specifications.--Where the original specifications required a sewer to run under the wide embankment of a railroad, and a diversion was arranged between the township engineer and the contractor by which the sewer was run under a bridge near by, thus saving the contractor a considerable sum of money, the township was entitled to no credit on account with the contractor for such saving, in the absence of a stipulation to that effect when the diversion was allowed. Inhabitants of Cranford Tp. v. Watters, 48 At. Rep. (N. J.) 317.

Discretion of City Engineers.—Baltimore City Ordinance No. 50, of 1900, authorizing the repaving of a street, and declaring that the paving shall be done with asphalt, but permitting the use of vitrified brick in lieu of asphalt in the gutters and on such other portions of the street as, in the judgment of the city engineer, shall be necessary, is not invalid as delegating to him the power belonging to the city council to determine what material shall be used. Mayor, etc., of City of Baltimore v. Stewart et al., 48 At. Rep. (Md.) 165.

Contract with Promoter.—A contract between a promoter and a pavement company whereby the former undertakes to secure the consent to introducing, extending, and securing the use of the pavement in a city, and to "use and make all reasonable, honest and lawful efforts to secure the right from the city * * * to make bids for laying such pavement or paving blocks on the streets of the city," is not void on its face, as being against public policy. Dunham v. Hastings Pavement Co., 68 N. Y. Supp. 221.

Engineer's Certificate.—In mandamus proceedings to compel the comptroller of New York City to draw his warrant in payment of a sum due relator, a public contractor, under a contract, the certificate of

the engineer in chief of the department of docks and ferries having jurisdiction of the work that there had been earned under the contract a sum sufficient to entitle the contractor to the payment represented by the warrant sought, was sufficient to establish a prima facie case in favor of relator. People, ex rel. Rolf, v. Coler, Comptroller, 68 N. Y. Supp. 448.

Obstruction in Street.—A platform slightly narrower than the sidewalk projected out over the sidewalk, on a level with the second floor of an abutting building. The building was used to store baled hay and straw, and the platform was used in unloading and loading the bales from wagons in the street below. *Held*, that the platform was not a nuisance and an obstruction in itself, so as to impose a liability on the city for permitting it to remain and be used for the purpose indicated, since the municipality had a right to presume that it would be properly used. Parmenter v. City of Marion, 85 N. W. Rep. (Iowa) 90.

Sidewalks Off Grade.—When a municipality, vested with the power of maintaining uniform grades of sidewalks, permits one proprietor to raise his sidewalk, and lets the grade of the sidewalk in front of the adjacent property remain out of grade for more than a year, and, owing to the abrupt rise of about five inches at the dividing lines of the two sidewalks (where there was a long shed, and no light), an accident happens, the city is liable for damages occasioned to a pedestrian who falls because of the obstruction and injures herself. Blume v. City of New Orleans, 29 So. Rep. (La.) 106.

Defective Streets.—A street connecting with a bridge at an angle extended five or six feet beyond the line of the bridge, leaving an exposed place, which led to one side of the bridge, and across an unguarded abutment into the river. A pedestrian about to enter the bridge was suddenly confronted by a bicyclist, and, to avoid a collision, jumped to one side and fell off the end of the street. *Held*, that, though the bicyclist had no right on the sidewalk, and the city could not have foreseen that he would be there unlawfully, he was not the proximate cause of the injury, but the city's failure to keep the abutment guarded, being a contributing cause, rendered the city liable. Knouff v. City of Logansport, 59 N. E. Rep. (Ind.) 347.

Contractor's Bond.—A bond given by a contractor to a city was conditioned that he should pay to any and all persons all money due for labor and material furnished, and that he should comply with the provisions of an ordinance, which provides that a person entering into a contract of construction with the city shall give a bond that he will promptly pay all persons supplying him with labor or materials in the work; and any person or persons applying therefor, and making affidavit that labor or materials for the work have been supplied by him or them and not paid for, shall be furnished a copy of the bond, on which he or they may bring suit, and prosecute it to judgment and execution, indemnity against costs first being furnished the city. *Held*, that separate actions on the bond can be maintained by different subcontractors, and that recovery of one judgment for part of the amount of the bond, and satisfaction thereof, does not prevent maintenance of actions by others. City of Philadelphia v. Stewart et al., 48 At. Rep. (Pa.) 275.

MUNICIPAL OWNERSHIP.*

By L. N. Case, Manager of the Water and Light Department, Duluth, Minn.

I can bring no stronger argument in favor of municipal ownership of public utilities than this: That, after a service of thirty-five years, connected with their operation by the people, thirteen years of which was passed in direct management of such operations, I am today more enthusiastic than ever in its favor—more thoroughly imbued with a belief in its profound justice, and more confident also of the great benefits to be derived therefrom by the common people, the great industrial and wage-earning classes; men, women and children, who are engaged in labor by which they secure to themselves and those dependent upon them the necessaries of life.

I have said that one-half of the people have nothing of this world's wealth, many not even a place to rest. There is one thing, however, that they do possess, and that is a common right and ownership in our streets and alleys, an inalienable right to all of the privileges of these public highways. The installation and operation of public utilities require the permanent occu-

*From a paper read before the Economic Club Feb. 27, 1901.

pation of a portion of this, the people's property.

This privilege is valuable. Wealth is seeking constantly for its possession, because of the large gains that can be obtained by thus occupying the property of the people and conveying to the people the necessaries of life. Gas, electric light, telephones, or street cars are not usually reckoned among the necessaries of life, and yet each, in its way, is necessary to the lives we lead. These privileges are being sought for persistently in every community of any size and are being obtained from the people, through their representatives, for a little or nothing, sometimes of course under the mistaken idea that franchises so granted will redound to the benefit of the people themselves.

The main objection to municipal ownership, an objection that is always urged, is that so corrupt are politicians and the representatives of the people, that they can not be trusted in the operation of these public utilities, and yet they are trusted to dispose of these privileges—give them away—barter them to purchasers at private and secret sales, the payments received for which, it is hardly necessary to state, never reaching the public treasury. I am free to admit that there have been failures in municipal ownership because of the corruption of politics, the spoils system and the incompetency resulting therefrom, but I hold that this is no logical argument against it. A violation of a principle is not an argument against it, neither is it an argument against a government by the people because unscrupulous men will always seek to take advantage of, and use it for their own private or dishonest purposes.

In the advocacy of the ownership of public utilities by the people, care should be exercised to preserve the principles upon which it is based. In Glasgow, not only do the people own and operate their water, gas and electric light plants, their street cars and other public utilities, but they are also engaged in the ownership and renting of a large number of tenement houses, as well as in other private industries. While the latter enterprises have tended to improve the condition and character of its people, by providing more wholesome and sanitary houses, healthier food and better clothing, yet I believe that they are in violation of the correct principles underlying municipal ownership. It seems to me that every reasonable and logical argument points to this general principle, that, when it is necessary to occupy the public property of a people in order to carry on a business, that business should be owned and operated by the people in whose interests it is established; and that the people, as such, should not engage in any business that requires only the occupation of private property and which can be maintained by private enterprise and private capital. If the argument is good that because it is a public utility it should be owned and operated by the public, it is equally as emphatic that if it is not of that nature it should not be so owned and operated.

As to the great benefits to be derived from municipal ownership, they can be summed up by the statement, that the people can supply themselves with these necessaries and privileges much cheaper and more agreeably to their needs than when furnished by a private company. And why?

First. It is the custom, almost invariably, both of municipalities and of private companies, to bond themselves for practically the entire cost of construction, the company issuing stock on top of this which represents nothing but the franchise value and the earning capacity of the plant. A municipality can usually float its bonds at par, with interest one or two per cent. less than can a private company. With the usual difference of two per cent. this means an annual expense of $20,000 for each million issue. For the purpose of forming an equation we will designate this expense by A.

Second. A company pays to a few of its trusted and prominent officials considerably larger salaries than are paid by a community; this with its legal adviser and expenses, which a municipality escapes, we will represent by B.

Third. It is generally understood that a company usually has a fund, called by some a "corruption fund," and which is used in obtaining its "right-of-way," to protect itself afterwards in that right and to insure its being "let alone." For this reason I presume, these expenses are frequently charged to "insurance." We will represent these expenses by the letter C—with a rising inflection.

Fourth. It must pay a reasonable dividend to its stockholders, which is really the purpose of its organization, and which we will will represent by D.

Representing the cost of operation and maintenance by the letter E, and the amount of income to be obtained from the people, which of course must be sufficiently large to meet all demands, by the letter I, we have the equation:

A plus B plus C plus D plus E equals I.

With a municipal plant the A, the B, the C and the D are eliminated and we have the simple equation E equals I which means that the rate of charge for the public service depends only on the cost of the operation and maintenance of the plant.

Municipal ownership has not advanced with as great strides in this country as in Europe, it being confined at this date almost entirely to the operation of water plants.

The latest compilation I have been able to

get is as follows: Water works owned and operated by the people, 1,690 out of a total of 3,196; over one-half. Electric light plants, 302. Gas plants, 12. Street railways, 1, the latter being on the bridge between New York and Brooklyn.

It is evident that the water supplies of communities, being greater necessities than those of light or locomotion, have forced the people's attention thereto and emphasized their demands for good and cheap service. This has resulted in communities largely obtaining possession of their water plants, which in almost every instance, has brought about these very ends demanded by the people.

In regard to other utilities, a less necessity for their use, and the ability of obtaining substitutes therefor, have been to a certain extent the causes of the people not awakening to a realization of the splendid results that can be obtained by acquiring them.

Philadelphia out of its net earnings has paid for its works, and had furnished cheaper gas during nearly all of its history than had the private works of New York, Baltimore or Washington. In 1894 it had done what the Standard Oil, Gould and Sage interests insisted before the New York legislature in 1897 could not be done without ruin, viz: reduced the price of gas to $1.

The works continued to pay operating expenses and depreciation charges, besides furnishing about 700,000,000 feet to the city yearly, worth at even 75 cents $500,000, or fully 5 per cent. on the structural value of the plant.

The recent reduction in this city of both gas and water rates, after a successful operation of these plants a little over two years, is a practical demonstration of this truth, and yet it is but little understood under what peculiarly adverse conditions these results have been produced.

In the first place there was paid for the plants about $350,000 more than their structural value, and although there were considerations that rendered the sum paid a reasonable one, yet it should not be forgotten that the interest on this excess has to be paid annually from the earnings of the works. Again the interest on $295,000 is at 6 per cent., being on the company's bonds and which in the transaction the city assumed, while it floated its own bonds at about 4½ per cent. In addition to this, the city borrowed $1,106,000 to be used in the construction of a supplementary system, and the extension and improvement of the old, upon which there is an annual interest of $55,000, an additional burden upon the earnings of the works. Finally the schedule of meter water rates, from which the department derived three-fifths of its income, was reduced by the council 20 per cent., and the gas rate was also reduced from $1.90 to $1.50 per 1,000.

It is no wonder that there were men in this community who, realizing how seriously the department was handicapped, should boldly state that it could not be self-supporting. I am even not surprised that when subsequent reports were made by the department showing that, notwithstanding these adverse influences, the department was paying, that there were some who claimed that the figures had been juggled. I could afford to smile, however, at these statements, for by that time I had acquired a sufficient knowledge of the conditions to already see the bright promises for the future which by no means, I assure you, are fully realized today.

Of the money borrowed for the building of the supplementary system and the extension and the improvement of the works, there was left for the use of the Board $102,000, with which it has made a large number of extensions, replaced about seven miles of worn out kalamine pipe lines with larger sizes of cast iron, have erected new houses at the pumping works and improved the machinery and grounds, have introduced new and improved apparatus for the manufacture of gas; in fact, a general upbuilding and improvement has been conducted and so judiciously as to call for little if any criticism. About $78,000 of this fund has been expended in this work, leaving still in the fund $24,000. In addition to this sum the board had in cash, cash assets and in operation materials paid for, $45,000 at the close of the year, with interest paid and with practically not a bill outstanding for labor or materials.

These results are but the results of Municipal Ownership, untrammeled by political influences, and operated on business principles alone.

To be successful Municipal Ownership must be real, not simulated; it must be public ownership complete—not private ownership by public officials. And when it is complete, the benefits accruing to the people are invariably widespread and far reaching.

MODERN BRICK PAVEMENT CONSTRUCTION.*

By W. H. Tarrant, City Engineer, Champaign, Ill.

The early brick pavements of this country, were, to a large extent, failures, because of a lack of knowledge of the requirements of a durable brick pavement and the inferior quality of materials available at that time. The first brick pavement which was constructed in the United States was at Charleston, W. Va., in 1872. This pavement had a foundation of three inches of gravel, well rolled, on this was laid inch boards dipped in coal tar, upon which was placed an inch and one-half sand cushion, then a course of common red brick laid on edge, herringbone fashion and a sand filler. This pavement did not give good results and in a few years was beyond repair.

The next effort to secure a durable pavement was the common two-course pavement, which we see in so many cities today. The earlier pavements of this class gave scarcely any better results than the Charleston pavement, owing to the inferior materials and construction.

A few years ago the construction of brick pavements with a concrete foundation was commenced. By rigid requirements in the specifications and the desire of the brick manufacturers to make more durable brick the result is that we have today the best brick pavements of any country in the world.

The object of this paper is to give a few of the many requirements of a brick pavement, with a broken stone concrete foundation, concrete curb and gutter and one course of brick. This class of pavement is the only one which will give satisfactory results. The writer will divide the subject of construction into the following heads:

First—Sub-grade.
Second—Crown of street.
Third—Concrete curb and gutter.
Fourth—Concrete foundation.
Fifth—Sand cushion.
Sixth—Laying and rolling the brick.
Seventh—Filling the interstices between the brick.

When an ordinance is passed for the paving of a street notice should be given the property-owners along the line of the proposed improvement to make the necessary gas, water, sewer and drain connections to their premises. In case this is not done by the property-owner, the city should make the connections and when the connections are used, charge the actual cost, with interest, to the party making the connection. All connections should be made under the direction of the city engineer or his assistants and should be made in a satisfactory manner. If, by reason of neglect or oversight the private connections are not made until the pavement is completed and the connections are desired, application should be made to the city clerk and an amount deposited sufficient to make the desired connection, concrete the trench and relay the pavement. The work should be done by the city, and when completed, if the amount deposited is larger than the actual cost of connection, the balance should be rebated to the applicant.

If at any time the city authorities grant a franchise or privilege to any company or corporation, necessitating the tearing up of the pavement to lay gas, water or any other mains or connections, there should be a stipulation in said franchise requiring said company or corporation to remove all surplus dirt from the trenches; and, after the mains are properly laid, fill the trench with broken stone or gravel concrete to the required depth; and, in case this is not done, fill the trench with cinders, gravel or well-tamped clay, to within eighteen inches of the top of the concrete foundation. Remove from the sides of the trench enough soil, commencing at the sub-grade and running outward at an angle of thirty degrees, to make a ledge of six inches on either side of the trench, filling the trench with gravel or broken stone concrete upon which to relay the pavement.

With the various connections completed before the awarding of the contract, there can be no delay to the contractor by reason of connections along the line of the work. The grading should be done in the following manner: Where excavation is necessary, no plow should be used within three inches of the finished sub-grade. The remaining excavation should be dressed off with hand tools. Where filling is necessary it should be done in layers of not more than four inches, each layer well dampened and rolled, all soft or spongy places should be removed and filled with gravel well rolled. The surface, after being brought to sub-grade (with allowance for rolling), should be thoroughly rolled with a roller at least five feet in width and weighing not less than two hundred and fifty pounds per inch of width. After the subgrade is thoroughly rolled and ready for the concrete foundation, no loaded or empty wagons or other vehicles should be permitted on the sub-grade, unless it be protected by a covering of boards. All paving material should be placed along the line of the proposed improvement before the completion of the sub-grade.

The cross-section of the street should be

*From a Paper Before the Illinois Society of Engineers and Surveyors, January, 1901.

PEARL STREET BRICK PAVEMENT, CAMBRIDGE, MASS.—MIXING AND PLACING CONCRETE BASE.

parabolic in form with the vertex of the parabola in the middle of the street. The writer finds excellent results by making the crown of the street equal to 0.014 the width of the street in feet plus 0.03 feet, the constant .03 of a foot being added to the middle ordinate of the street so as to slightly elevate the center and thus avoid a flattened place in the street. By this method we secure better drainage and a cleaner street.

For the residence portion of a city there is no one feature of a brick pavement which adds more to the pleasing appearance of the street than a concrete curb and gutter, and when properly constructed and first-class materials are used it will be as durable as any other portion of the pavement. The the gutter should have a width of eighteen inches and the curb a thickness of five inches for a street having a width of thirty-six feet. The gutter should have a slope of one inch toward the curb. The hight of the curb above the gutter should be seven inches, the upper face edge and the junction of the curb and gutter should have a radius of one and one-quarter inches. The thickness of the gutter should be six inches and the curb five inches, and the construction should be such as to make the curb and gutter one solid mass.

The foundation should be six inches of gravel or cinders, well dampened and thoroughly tamped with a tamper, having an area of not less than thirty-six inches and weighing not less than thirty pounds. The concrete portion of the curb and gutter should consist of one part Portland cement and five parts clean gravel. The cement and gravel should be thoroughly mixed dry, then water added until it is a little more than moist, then placed in forms and well tamped with a tamper, as described for the foundation. The writer is of the opinion that the secret of a first-class concrete curb and gutter is to have the concrete well tamped. The finishing coat should be one inch in thickness and consist of one part of Portland cement and one and one-half parts of clean, sharp sand. The finishing coat should be placed on the concrete portion before the concrete has begun to set, and thoroughly troweled, so as to give a perfect bond between the two. If this precaution is taken there need be no fear of hollow blocks. The concrete curb and gutter should be made in alternate sections and in lengths of seven feet.

The finished curb and gutter should be protected from the sun and wind by a covering of canvas for at least twenty-four hours. In extremely dry weather the curb and gutter should be sprinkled at least once a day for three or four days. The catch basin inlets should be built in the curbs. The best form of inlet is the cover inlet with vertical bars. This inlet will never become clogged by leaves or rubbish on the street.

One of the most important parts of a durable brick pavement is the concrete foundation or sub-structure for the brick. This is one portion of the pavement which, in many instances, is neglected, and one which should have the greatest care. One of the primary elements of a first-class foundation is to have a perfect sub-grade upon which to lay the concrete.

The concrete should be composed of one part of American natural hydraulic cement, two parts clean, sharp sand and four parts of broken stone. If Portland cement is used instead of the natural cement the proportions should be one of cement, three of sand and six of broken stone, or if the gravel is used instead of the broken stone, one of Portland cement to eight of gravel. In recent experiments with the broken stone concrete and gravel concrete (using the natural cement in the broken stone concrete and the Portland cement in the gravel concrete), the gravel concrete gave an increase of strength of 30 to 50 per cent. over the broken stone concrete. The thickness of the concrete foundation should be six inches, and under all street car tracks the concrete should have a depth of six inches below the bottom of the ties.

The sand and cement should be thoroughly mixed dry until it has a uniform color. Add enough water to give it the proper consistency; then add the broken stone; mix three times and then shovel into the work. To give the surface of the concrete foundation the proper crown, the best method is to set a line of stakes along the center of the street about three feet apart, then by means of a templet with one end on the center stakes and the other on the curb, set a line of stakes perpendicular to the curb line and about three feet apart, driving the stakes to the exact surface of the finished concrete. By this method the grader has ample opportunity to bring the surface to a perfect grade.

One of the most important parts of the concrete foundation is the tamping of the concrete, and it is one which is very often neglected. The concrete should be thoroughly tamped with a tamper weighing not less than thirty pounds and having an area of not more than twenty-five inches. After it is sufficiently tamped with the iron tamper and any hollow places appear, they should be filled with cement mortar and again tamped with an oak tamper about eighteen inches square. The surface of the concrete should then be parallel to the surface of the finished pavement. Much depends upon this, and if not done the pavement, when completed, will be flat in places and have a wavy appearance. After the concrete has set a few hours it should be covered with a half inch of clean, moist sand. In extremely dry and hot days it should be sprinkled a

PEARL STREET BRICK PAVEMENT, CAMBRIDGE, MASS.—PLACING THE BRICKS ON SAND CUSHION.

few times each day until the bricks are laid.

The sand cushion should be of clean dry sand and have a thickness of one and one-quarter inches. The sand should be graded by means of a templet, having the exact contour of the street. It should be so constructed that one end of the templet will rest on strips in the center of the street and the other end on the curb. The sand at all times should be perfectly dry.

The bricks should be laid in rows perpendicular to the curb, except at street intersections where they should be laid at an angle of forty-five degrees. Bats should be only used in commencing the rows and making the closures, and in no other places. The brick should be laid with the least possible space between them. Wheeling on the pavement should be done on boards and the brick should be dumped from the barrows in the direction of the rows. After the brick are laid they should be carefully inspected, all chipped brick should be turned, the soft and defective ones should be thrown out and replaced with good ones.

The best method of laying brick between street car tracks is to lay the brick parallel to the rails. One row on the outside of the rails should also be laid parallel to the rail. This row gives the trackmen a chance to tighten up the bolts or drive spikes without molesting more than one row. The first row on the inside should be laid flat, when a six-inch "T" rail is used. The remaining rows are laid on edge and if the three and three-eighths-inch brick are used no cutting is necessary.

The rolling of the brick should be done parallel to the curb, commencing at the center and rolling toward the outside. It should be done with a roller weighing not less than 200 pounds per unit inch in width. The pavement should be rolled at least three times. After the rolling is done the brick should have their final inspection and all broken or chipped brick removed, and replaced with good brick.

If the brick are standard brick and not repressed, sand makes the best filler, but if they are repressed brick the Portland cement should be used. If the manufacturers of paving brick would discontinue the use of the repress machine we would have a better quality of brick. The repressing of the brick destroys the bond which is given the clay when it comes from the brick machine and the repress machine does not put enough pressure on the brick to make a new bond. The result is that after the brick are burned and placed in the street they scale off on the edges. In the standard brick the bond is not broken and the brick do not scale or chip in the street.

If the sand filler is used the sand should be clean, sharp, dry and fine. The sand should be placed on the street in thin layers and thoroughly broomed into the joints with steel brooms. When the interstices of the pavement are all filled a half inch of sand should be left on the pavement.

If the grout filler is used it should consist of one part of Portland cement and one part of clean, sharp sand. The cement and sand should be thoroughly mixed dry, in a tight box about two and one-half feet wide and about four feet long; water should be added until it has the consistency of thick cream, then poured on the pavement and broomed into the joints. It should be applied in two courses, the second course be mixed a little thicker than the first. When the joints are well filled and the cement is allowed to set for a few hours, a coat of sand should be placed over the pavement to protect the grout from the wind and sun. The grout should be allowed to set from seven to ten days before the traffic is turned on the street.

CURRENT INFORMATION

Connecticut Sewerage Commission on Sewage Disposal.

The second annual report of the Connecticut sewerage commission summarizes the views of that body on the different methods of sewage disposal now in use as follows:

1. The chemical precipitation of domestic sewage, first and most extensively practiced in England, has proved to be very unsatisfactory. It is very expensive and at best can only prepare the sewage for purification, a work cheaply and effectively done by the septic tank. A single possible use for it is this: Where many large adjacent manufacturing establishments contribute chemicals and very refractory waste matters which are injurious to the bacterial life of the filters, it may prove to be economical to separate them in a special sewer and make them innocuous by chemical precipitation. Probably the sludge thus made would carry less water and be more dense than that from the treatment of house sewage, and its disposal for these reasons would be less burdensome.

2. The cleansing of sewage by bacterial action is the only method which seems, at present, to give promise of widely successful application. To the study and practical operation of this method the work of all sanitary engineers is at present directed. No other known method actually destroys the putrescible matter in sewage, making the effluent clear, not poisonous to fish and incapable of putrefaction. No other known method can, therefore, perfectly satisfy reasonable requirements in those cases where

PEARL STREET BRICK PAVEMENT, CAMBRIDGE, MASS.—SPREADING PORTLAND CEMENT GROUT.

the effluent must be discharged into streams or shallow harbors.

3. Largely by the experiments and advice of the Massachusetts State Board of Health the capacity, durability and efficiency of sand filters for the bacterial treatment of sewage beds has been determined. With a sufficient and not exceedingly large area, crude sewage can be handled on them, yielding very clear and clean effluents. There is no clogging of the filters, and while their efficiency is very considerably reduced in severe winters—owing partly to the lessened activity of the bacteria in them, and partly to the impossibility of cleaning the surface of the beds—they are operated successfully the year through in Massachusetts and in Connecticut.

Sand filters themselves efficiently screen the sewage. The sludge, consisting of paper with solid animal and vegetable refuse of all sorts, does not work down into the sand, but stays on or close to the surface, and if not removed simply retards the work by checking the flow of sewage into the sand. When the filter rests, this sludge dries to a thin crust, easily removed by raking, and is composted or directly plowed in, making a fairly good fertilizer.

4. The sand filter has its limitations. In the first place, for cleansing the sewage of very large cities ,the filter area must necessarily be very large and relatively much more expensive because of the high cost of land near large centers. Secondly, only very open, coarse sand can be profitably used for filters, and such sand is often not to be found where it is needed for the purpose. This last condition prevails almost everywhere in England, and has made necessary the very expensive and elaborate experiments with socalled bacterial beds.

5. Bacterial beds are artificially made, being filled with some kind of broken material very much coarser than sand. Burnt clay, furnace clinker, coal, even crushed granite and refuse metal scrap have been used. The depth of the filters is usually from 3½ to 6 feet, though in some cases it has been as great as 13 feet.

The method of operating these filters is quite different from that used for sand filters. The latter are flushed with sewage which is allowed to sink through the sand, the sewage rests for a day or more, the beds are raked, and then flushed again. The former are filled slowly up to the surface of the filtering material with sewage, which is allowed to stand for two or three hours and is then slowly run off. After a rest of only a few hours, the operation is repeated, two, three or four times in twenty-four hours. The effluent from the first or roughing filter is usually passed to a second, filled with finer material, and in a few cases to a third, but the third contact is exceptional.

6. This system at its best will unquestionably handle six or eight times as much sewage as an equal area of sand filters. The effluent is not nearly as pure, but pure enough to meet the present requirements of senitary authorities. The climate of England in winter, which is much milder than our own, does not appear to very seriously affect the working of these beds if the sewage is applied as described. An automatic sprinkling device for continuously applying the sewage to the surface is reported to have disabled the bed in freezing weather and would certainly do so in Connecticut winters.

7. The bacterial bed, like the sand filter, also has its limitations, which are now fully recognized by all English authorities. The material of these beds is so coarse that sludge is not held on the surface but readily passes up or down, depending on the manner of filling, into the body of the filters. A considerable part of it is liquefied and destroyed there, the bacterial filter thus operating like a septic tank, but a part is very resistant and fills up the interstices more or less.

This filling, with careless or unskillful management, is very rapid; with skillful management it is slow. The commission believes, however, that the experience even with screeened and settled sewage has not yet proved that this filling can be wholly prevented, and that it rather indicates that with all possible care sewage will so seriously impair the filters in no very long time as to make renewal necessary, unless practically all the sludge is removed from it by some preliminary treatment. This operation of renewal, at least under Connecticut conditions, would be very expensive.

8. This brings up again the problem of the removal and disposal of sludge, the suspended matter in sewage. No mechanical arrangement of gratings or sieves has yet been devised which can do the work required. Once remove the sludge and the problem seems to be solved. If the sewage is free from it, there is no reason to doubt that the bacterial filters can handle seven or eight times as much sludge-free sewage as an equal area of sand filters can handle of crude sewage, and will maintain their efficiency indefinitely.

The most efficient means of removing this sludge has proved in England to be the septic tank. It has long been in successful operation at Exeter; at Sutton it has insinuated itself into use with a system originally devised to remove the sludge by a roughing filter; at Manchester it has been finally adopted as part of the disposal system of a great manufacturing city, by a commission of undoubted ability, which made a thorough test of it. It may be that the septic tank, in some places and with some kinds of sewage, will prove unnecessary, and that the whole work can be done on bacterial filters.

Any careful observation of a number of sewage-disposal works emphasizes the fact that while the broad principles involved are the same everywhere, no two problems are precisely alike, and each particular case has to be studied by itself and the system modified to meet local conditions and the special character of the sewage to be treated. It has still to be determined whether the septic tank and bacterial filter can be used in the Connecticut climate in their present shape, or whether they can be so modified as to be successfully operated here during the summer and winter. The work of sewage disposal in England under the special conditions imposed by the demands of sanitary authorities, the general character of the soil and the geographical situation, is still in the experimental stage. No large manufacturing

centers have disposal works which have been in perfectly successful operation for a considerable number of years. The septic tank is no longer an experiment. The bacterial filters operating on sewage quite free from sludge are, the commission believes, certainly successful, and will continue so indefinitely without renewal. At any rate, the work now being done at Manchester will, if managed with the same skill as the preliminary experiments, finally settle these two points.

9. The cleansing of the sewage of large manufacturing cities is often made specially difficult because of the discharge into sewers of manufacturing waste water either containing in solution various chemicals which greatly interfere with bacterial filters or carrying in suspension material which clogs these filters. Examples of such matters are pickling acid, soap, paper-mill waste, bleach and gas liquors. These have at present to be accepted in the sewers and cared for by the city. In many cases, however, such waste could be, in part, at least, kept out of the sewers and out of the waterways by private manufacturers, without loss and even with a profit to themselves. The following interesting examples are described by Dr. W. H. Wilson:

The county of the West Riding of Yorkshire (which includes the cities of Leeds, Sheffield and Bradford, and the boroughs of Halifax and Huddersfield), has a population of 2,444,391, engaged chiefly in the manufacture of textile goods, leather, iron and steel, and in coal mining. In this county there are more than 2,000 factories discharging trade refuse into the sewers or streams. Those manufacturers in the iron trade who used to discharge waste pickle, made from sulphuric acid, have found in several cases that it is easy to obtain from this pickle by crystallization the copperas it contains, and to use over again the acid mother liquor, and in this way to cease discharging the waste pickle into the stream, and at the same time to affect an economy by its treatment. The manager of the Hallanshire paper mills, near Sheffield, has assured the board's inspector that he is able to rinse the fiber, etc., caught in the settling ponds he has provided for the treatment of his trade waste, and that by so doing he has far more than recouped himself for the cost of the works. The manager of the Calder Grove paper works, near Wakefield, also states that all the sludge deposited from the waste water in the settling tanks he has provided, can be made up into paper. In both these cases the sludge is used also with other materials for the manufacture of the coarser kind of paper. In the case of bleach works it has been found that the measures adopted by the manufacturers have resulted in a saving. The occupier of the Woodside bleach works, Rawdon, has saved £6 a month by rinsing the bleach liquor which formerly he discharged into the stream. At several soap works the manufacturers have erected plants for the recovery of the glycerine from the lyes and have thus stopped the former pollution of the stream and at the same time made a profit.

The commission makes the following recommendations:

1. The disposal of sewage without nuisance is a duty which each community owes to the public. It is a problem to be settled by each community for itself, with such state supervision and control as is necessary in the public interest.

2. No city, borough or town which has not now a sewerage system should be allowed hereafter to build one which will discharge sewage or polluted water into any stream, whether such stream at the time is used by others for sewage disposal or not; nor should private corporations or individuals be allowed to discharge house sewage or excreta into any streams or rivers.

3. To insure sewerage construction and methods of sewage disposal which will be permanently satisfactory, the general assembly should not grant to any corporation, not now operating a municipal sewerage system, authority to issue bonds for building, or to condemn land for building, or to build any sewers or system of sewers, until an accurate topographical survey of the region to be sewered has been made, and, together with plans for effective sewage purification before discharging the effluent into any stream, has been submitted to and approved by some competent state authority.

4. Provision should also be made by which cities and boroughs now having sewage disposal works, or which may hereafter build them, may be compelled by the state to so manage them that the sewerage shall at all times be effectively purified, so as not to create a nuisance by its discharge into rivers.

Bacterial Treatment of Sewage at West Bromwich, England.

A report on bacterial treatment of sewage at West Bromwich, England, by A. D. Greatorex, borough engineer and surveyor, has been adopted by the town council. The beds have been in operation over twelve months. The beds, both coarse-grained and fine-grained, are 120-ft. long by 60-ft. wide. They are constructed at right angles to the main outfall conduit, the walls being of 18-in. brickwork in cement mortar on concrete foundations, the floors of the beds also being of concrete. The average depth of the filtering material in the coarse-grained bed, which is screened engine ashes from ½-in. to 2-in. mesh, is 3-ft. 6-in., and in the fine-grained bed, which is screened engine ashes from a ¼-in. to ½-in. mesh, is 3-ft. By means of three 15-in. penstocks the sewage reaches the coarse-grained beds direct from the main outfall sewer. The troughs for distributing the sewage are of iron, 15-in. wide, laid upon the surface of the filtering medium. The beds are not under-drained, but have six- 4-in. sluice valves on either side connected to 6-in. and 9-in. cast iron pipes, which discharge into manholes at the bottom end of the beds. The coarse-grained bed discharges into the fine-grained bed, and the fine-grained bed discharges into a 12-in. earthenware pipe, which is connected to a pump well near the engine house, whence the effluent is lifted onto area No. 11, in accordance with the conditions laid down by the local govern-

ment board. Each of the beds has an effective area of 800 sq. yds., or 1-6 acre.

The sewage was turned on to the beds on Oct. 3, 1899, and they were worked daily until Nov. 1, from which date the beds received two fillings each per day until Nov. 20, when they were filled three times per day until Dec. 5, when they rested until Dec. 12. From this date up to the present they have received three charges per day, Sundays excepted in all cases. From Nov. 1, 1899, to Nov. 1, 1900, the beds received 813 charges of rough-screened crude sewage. The object of the coarse-grained bed is not to effect the final purification of the sewage, but to take the place of the usual chemical treatment, settling tanks, etc., leaving the final purification to be carried out by the finer beds or land.

The coarse-grained bed constructed on the high level is 60-ft. long by 42-ft. wide, adjoining the existing detritus tanks, built in a similar manner to the low-level beds, with an average depth of filtering material of 3 ft. The sewage passes first through the detritus tanks, then through two 15-in. valves on to the bed, being distributed by means of two 15-in. cast iron troughs. The outlet for the filtrate is made by means of six 4-in. valves connected to 6-in. and 4-in. cast iron pipes, discharging into two manholes, and thence by means of a 9-in. earthenware pipe onto area No. 18, the land taking the place of the fine bed. The area of this bed is 280 sq. yds., or about 1-17 acre. The sewage was first turned on to the coarse bed Sept. 12, 1899, the crude sewage being first passed through the detritus tanks. The bed was worked twice every 24 hours, except Sunday, until Nov. 20, 1899. Since that time the bed has received three charges per day, except Sundays, with the exception of a rest from Dec. 5 to Dec. 12. From March 1, 1899, to Nov. 1, 1900, the bed has received 816 charges of crude sewage.

The method of working the beds is as follows: The sewage flows into the coarse-grained bed until the water level has nearly reached that of the bed material. The inlet valves are then closed and the bed allowed to stand full during about two hours. If much longer time is allowed, there is danger of anaerobic action replacing the aerobic, if much less, insufficient time is given to the organisms in the bed to perform their proper functions. During these two hours the suspended matters are deposited in the interstices of the bed, and are partly dissolved while the organic matter in solution is also attacked and oxidized to the extent of about one-half. The bed is then emptied on to the gravel bed, and a resting period of equal duration is allowed. Any quantity of suspended solids that may have escaped the coarse bed, is finally arrested, rendered soluble and oxidized and the purification of the dissolved putrescible matters is continued. When land of a suitable character is available the second series of beds may be dispensed with, the effluent from the first set being very suitable for irrigating purposes, inasmuch as the task thrown upon the land is greatly lightened, there being no suspended matters to clog the pores of the soil, and while the mineralisation of the dissolved organic compounds, which must take place before they are available as plant food, is already far advanced, the material value remains, but many of the troubles incidental to sewage farming are removed.

The report says that the work of a bacteria bed is not finished when the effluent has been discharged; there remains in the bed the sludge, of which only a portion will have been dissolved and oxidized while the bed was full.

The interstices of the bed being now filled with air, which replaces the water as the latter flows away, the aerobic organisms are provided with the conditions necessary for their well-being and rapid reproduction; they have food, moisture, oxygen, darkness and an even temperature. Under these circumstances the deposited organic matters are rapidly attacked, and in the course of a few hours the bed is ready for another charge.

The beds are allowed to stand empty for three hours, and are used three times every twenty-four hours.

The final effluent is clear, entirely without odor, remains perfectly sweet on keeping, is not liable to secondary offensive or putrefactive decomposition, and is fit to discharge into the River Tame, however small the relative volume. Since the beds have become regular in their action neither the effluent nor the beds have become foul.

It will be seen, therefore, that the action of the bacteria beds gives us something beyond mere filtration—viz., a chemical action upon the organic matters in solution and evidently a much greater purification than is represented by the mere withdrawal of suspended matters, as, in addition, it digests the organic solids left behind, a process which, if incomplete, can probably be completed by adequate periods of rest.

The report points out that the object of these beds was to determine whether the sewage of West Bromwich could be successfully treated by the biological methods at all times of the year. The object of the fine-grained bed on the low level was to prove whether the effluent could be satisfactorily purified without any application to land so that by the construction of such beds a saving could be made in pumping. As constructed the beds are so arranged that they will be permanently utilized to purify sewage and consequently no expenditure on structural works or materials has in any sense been wasted or lost. The report says:

In order that a bacterial contact bed may exercise its full powers of purification it is necessary—

(a) That it should be allowed sufficiently frequent and prolonged periods of rest.

(b) That the sewage applied to it should, as far as posible, be free from suspended matter.

(c) That the sewage applied to it should be of as uniform a character as possible.

The above conditions are best secured by passing the sewage as it arrives at the works through an adequate system of screens and tanks. Sewage contains in suspension and in solution organic and mineral matter; the mineral matters in suspension, such as grit, must be removed by the settlement before subjecting the sewage to bacterial treatment; such an arrangement has the further important advantage of leading to the development of those anaerobic or septic processes which resolve into gaseous and soluble products the organic suspended matter present in the sewage. A large proportion of the sewage which would otherwise accumulate, and the disposal of which is the source of so much difficulty and expense, is thus abolished. The above anaerobic or septic process is found to take place as effectively in an open tank as in a closed one.

The sewer committee authorized Mr. Greatorex to have the necessary samples of sewage and effluents in connection with the experimental works analyzed by H. Silvester, the borough analyst. The various sewages and effluents were mixtures of samples collected, some half hourly, and some every quarter of an hour, throughout periods to insure, so far as practicable, the same sewage being analyzed throughout the process. The analyses of the numerous samples of crude sewage and effluents were as follows:

The average amount of suspended matter contained in the sewage for the low-level trials was 77.39 parts per 100,000, or 54.17 grains per gallon, and it will be seen from the average results of these analyses that the matters in suspension in the crude sewage were reduced in the filtrate from the coarse-grained bed to 9.34 parts per 100,000, or 6.54 grains per gallon, and were still further reduced to .95 parts per 100,000, or .66 grains per gallon, in the final filtrate from the fine-grained bed. The effluent from the land contained traces only.

The reduction of the oxidisable matters in solution was from 3.251 to 1.512 parts per 100,000, and then to .457 parts per 100,000, thus showing an average reduction equal to 53.4 per cent. by the coarse-grained bed, and a total reduction equal to 85.9 per cent. by the combined beds. The total purification after land treatment was 88.9 per cent., the oxidisable matter being reduced to .460 per 100,000.

The reduction of the nitrogenous organic matters, as indicated by the albuminoid ammonia, was in like manner 47 per cent. by the coarse-grained bed and 78.6 per cent. by the combined system. The total purification after land treatment was 82.4 per cent.

The average amount of suspended matter contained in the sewage for the high-level beds was 60.97 parts per 100,000, or 42.68 grains per gallon, and it will be seen from the analyses that the matters in suspension in the crude sewage were reduced in the filtrate from the coarse-grained bed to 6.46 parts per 100,000, or 4.52 grains per gallon, and were still further reduced to .66 parts per 100,000, or .46 grains per gallon in the final filtrate from the land.

The reduction of the oxidisable matters in solution was from 5.034 to 2.165 per 100,000 and then to .369 parts per 100,000, thus showing an average reduction equal to 59.9 per cent. by the coarse-grained bed, and a total reduction equal to 92.6 per cent. by the combined bed and land treatment.

The reduction of the nitrogenous organic matters as indicated by the albumnioid ammonia was in like manner 54.6 per cent. by the coarse-grained bed and 93.2 per cent. by the combined system.

As the chlorine in the sewage is higher than in the final land effluent, a slight correction is necessary to make the effluent strictly comparable with the original sewages. Reducing the sewage and effluent to a common chlorine standard, the percentages of purification are as follows: From oxygen absorbed figures, 90.7 per cent.; from albuminoid ammonia figures, 91.5 per cent.

The results have been all that could be desired, and after twelve months' working the beds are now in as good a condition and as free from nuisance as they were after the first filling.

In order to show that the effluents from bacteria beds are better than the water in the River Tame, analyses of water from the River Tame above the sewage farm were made.

The capacity of bacterial contact beds has been found to remain practically constant after they have been in operation for a period of three months, and in round numbers is said to be about one-third of the tank capacity. Gaugings were taken at Friar park to ascertain the capacity of the beds from time to time, and it has been found that this capacity is somewhat less than one-third of the tank capacity, being only about one-fourth. This is due to the want of proper detritus tanks, and will be obviated in the scheme proposed.

The bacterial system of treatment is efficacious at all seasons of the year, the temperature of the sewage being sufficient both to prevent any stoppage of the beds by the formation of ice and also to maintain the necessary activity of the bacteria even in the coldest weather. On no occasion has any difficulty been experienced in working the beds during frost. The comparatively high temperature of the sewage, even in the coldest of weather, is of importance, not only in preventing the choking of the beds with ice, but also because such a temperature is necessary for the exercise by the bacteria of their functions of purification.

The experiments show that the sewage of West Bromwich can be successfully purified by the bacterial process.

The bacterial system of treatment is efficacious at all seasons of the year.

The final effluent from the fine-grained bed on the low level is sufficiently pure to discharge into the stream without being applied to further land treatment.

The low-level sewage should be passed through detritus tanks, so as to remove as much mineral and suspended matter as possible.

The detritus tanks on the high level require to be enlarged, as they are of insufficient capacity to deal with the quantity of sewage discharged by the high-level outfall sewer.

I am now in a position to report that the experiments together with very careful observation in treating the sewage of West Bromwich, have enabled me to decide to recommend, without hesitation, a process and scheme which I have every reason for believing will successfully meet your requirements for a long time to come.

Before explaining such scheme it is necessary to point out the conditons laid down by the local government board. As at present advised the board consider whatever system is adopted as a means for dealing with the sewage, it is necessary that provision should be made in the scheme for—

1. Treating fully as ordinary sewage a volume of mixed sewage and storm water equal to three times the daily dry weather flow of sewage.

The board has, however, lately modified this clause as follows: Where a separate system is in existence, and where the sewage is domestic only, the volume of sewage and storm water to be fully treated as foul sewage may be reduced to twice the dry weather flow instead of three times, as formerly required.

2. Dealing with the excess of storm water up to six times the dry weather flow, either by passing it through a special and separate storm filter of sufficient extent, or by delivering it in a special area of prepared land other than that in use for the treatment of the effluent from the ordinary tanks and filters.

If a special storm filter is provided for this purpose it should be of sufficient extent to allow a rate of filtration of 500 gallons per square yard per diem.

3. The capacity of the beds to be taken at one-third for the fluid and two-thirds for the filtering material.

4. That bacteria beds shall be worked in cycles of not less than eight hours for filling, emptying and rest for aeration.

In view of the experience gained I beg to suggest as follows:

1. That the sewage of the low level be passed through detritus tanks, so as to retard the flow of the mineral and organic matters in suspension. These tanks, I suggest, should be three in number.

2. That the settled sewage from the detritus tanks can be passed through a series of bacteria beds, both coarse and fine, nine of each number (of which the existing two will form part), constructed of the same size and area as the two existing beds, but will be one foot deeper. The total area of these beds will be 14,400 square yards, and should, according to the local government board's requirements, be capable of treating 1,600,000 gallons per twenty-four hours. The final effluents from the fine-grained beds to be collected and passed over an aerating bed, having an area of about one thousand square yards, and thence direct into the brook. If the final effluent has to be pumped, I would suggest that areas Nos. 14, 15, 16, 17, 18, 19 and 20 be reserved for this purpose. These areas have a collective area of about forty-seven and one-half acres.

3. That the flood-water after the first washing of the sewers be treated on areas Nos. 1 to 9 and 11 to 13, which have a collective area of about thirty-four acres. This will allow for the treatment of about 3,000,000 gallons of storm water per day.

4. That the high-level sewage, after it has passed through the existing detritus, be treated on nine coarse-grained bacteria beds, constructed of the same size and area as the existing bed, only one foot deeper. The total capacity of these beds will be 2,160 square yards, worked in the same manner as the lower beds, and should, according to the local government board's requirements, be capable of treating about 540,000 gallons per twenty-four hours.

5. Additional detritus tanks should be provided, or the coarse-grained bed converted into a detritus tank and lengthened by about forty feet. This is provided for in the estimates.

6. That the effluent from these beds be conveyed by means of earthenware pipes to areas Nos. 26 to 30, and treated by them instead of fine beds. They have a collective area of about twenty-eight acres. Thence it will pass directly into the brook.

7. That area No. 23 be filled with rough ashes, to form a special storm-water filter. This filter would, I feel sure, successfully deal with the excess of flood water beyond the bacteria beds. It should be capable of treating 2,000,000 gallons of storm water if filled to an average depth of three feet.

It will also be necessary to under-drain the remaining suitable areas of the farm, which have a collective area of about twenty-two acres.

Sanitary Regulations in London.

The general purposes committee has recently submitted to the London county council a report on the result of a conference with the representatives of the city corporation and the various metropolitan vestries and district boards for the purpose of considering sanitary subjects, for the control of which additional powers are necessary.

With reference to house refuse and its removal the report says:

What may be described as the most primitive conveyance in use in London is a two-wheeled cart, open at the top and provided with a tarpaulin, which is usually kept folded up in front, but is sometimes used after the loading has been completed. The cart is loaded by the assistance of a short ladder placed against the side, and the bin or basket is tipped into the open cart, permitting the dust to be blown on to passersby, and paper and similar light material to be scattered over the road.

An improved conveyance employed by

some of the authorities is a covered one, with wooden or metal flaps, and a yet further improvement is a wagon with an iron top divided into sections, which slide to admit of the bin or basket being tipped, the object of the divisions being twofold—firstly, to limit the exposure of the contents of the vehicle; and, secondly, to facilitate loading evenly, and thus utilizing the entire capacity of the van. Objections have been made to this kind of wagon, because the slides were apt to get fixed, owing to a want of a little care on the part of the men. The opinion was, however, expresed at the conference that the men could be trained to the proper use of the sliding covers.

The conference, having in view that various districts of the metropolis might want different kinds of vehicles, contented themselves with passing the following resolutions based on a general principle: That in the opinion of the conference carts and wagons for the removal of dust, etc., should be so constructed as to prevent, while loading and removing, the escape of their contents, and also, as far as possible, bad smells; and that the open carts of the fashion at present in use should be fitted with a tarpaulin cover, supported by a longitudinal bar.

In the event of a scavenger's cart fulfilling the above conditions not being employed, the conference considered it desirable that some alternative system should be adopted. They accordingly passed the following resolution: That as an alternative system to an improved scavengers' cart the best system of removing dust, etc., would be by using duplicate bins, one containing the refuse being removed from the house and placed on a trolley and an empty one left in its place at the house. We are informed that in some towns the bins are provided by the sanitary authorities for the householders, who pay a small annual sum for their hire.

As regards the times for removal it was stated that in some districts of London occupiers objected to the frequent collection of house refuse. In Edinburgh and some other places the system is to collect daily from every house. The conference, with a view of discouraging the accumulation of house and other refuse, resolved: That, in the opinion of the conference, house refuse should be removed daily where practicable.

Mention having been made of the danger and inconvenience caused by scavengers owing to house refuse being sometimes kept in inaccessible places, it was resolved: That it would be desirable for the council to make a by-law requiring the provision of proper access to the receptacles for house refuse, and especially so as to avoid climbing area railings and descent by ladder to the basement.

The council's by-law with respect to dust receptacles is as follows: When any person shall provide an ashpit in connection with a building he shall cause the same to consist of one or more movable receptacles sufficient to contain the house refuse which may accumulate during any period not exceeding one week. Each of such receptacles shall be constructed of metal and shall be provided with one or more suitable handles and cover. The capacity of each of such receptacles shall not exceed two cubic feet: Provided, that the requirement as to the size of each of such receptacles shall not apply to any person who shall construct such receptacle or receptacles in connection with any premises to which there is attached as part of the conditions of tenancy the right to dispose of house refuse in an ashpit used in common by the occupiers of several tenancies, but in no case shall such ashpit be of greater capacity than is required to enable it to contain the refuse which may accumulate during any period not exceeding one week. The conference thought it was undesirable to make any alterations as regards the dust receptacles specified in the by-law made by the council. On the question of fixed ashpits, however, the conference passed the resolution: That, in the opinion of the conference, it is desirable that fixed ashpits should be abolished and movable receptacles provided in their place.

With reference to cleaning streets and footpaths, watering, etc., the report says:

The best method to be adopted for cleansing and watering of roads is one presenting considerable difficulty, having regard to the various kinds of paving in use. Having given the matter careful attention, the conference has passed the following resolutions: That, in the opinion of the conference, all streets paved with asphalt, wood or granite setts, should be well washed, after first sweeping off and removing all the rough dirt and cleaning the channels, the local authorities providing properly constructed catchpits. That, in the opinion of the conference, greater supervision of the scavenging is absolutely essential to insure the efficient cleansing of the roads and footways of the metropolis, and that the surveyor to the local authority should have sole responsibility for, and unrestricted control over, all labor employed. That as a general proposition, where they can be suitably employed, machine brooms are to be preferred to hand labor. That, in the opinion of the conference, it is desirable that local authorities should provide sweepers for specified areas for the systematic sweeping of the crossings of main thoroughfares. That, in the opinion of the conference, the sprinkling of roads should be done by vans or carts, and that, having regard to the various considerations which apply, it is preferable to water the sides of the roads and channels as frequently as necessary to lay the dust, and the center of the road at less frequent intervals, with the idea that the road shall not be all wet at the same time.

The question of the material to be employed for making up roads being one of

considerable importance, a sub-committee was appointed to consider and report upon the matter. The result of their deliberations was to show that, speaking generally, it was inadvisable to prescribe one particular form of paving for all streets. The conference, after discussing the question at some length, decided to take no action in the matter.

In connection with the question of best way of showing the names of streets, the conference passed the following resolution:

That, in the opinion of the conference, the best means of showing the names of streets on buildings is by means of painted iron name-plates at the corners and intersections of streets; that the best means of showing the names on lamp-posts is by means of opal tablets in the public lamps, the letters being burnt in the glass itself; that the names should be attached to the lamps or lamp-posts in such a manner as to be visible both by night and by day; that the names of thoroughfares should be placed at all interesections of cross streets; that the building act committee of the council be requested to consider the desirability of more stringent regulations being passed for the prevention of the wilful injury of street tablets.

In connection with building operations the conference had their attention directed to the question of hoardings, and the annoyance caused by dust during the demolition of buildings. The control and licensing of hoardings is in the hands of the local authorities. It was felt that steps should be taken for limiting the period for which hoardings remain up. The opinion was expressed that there had been frequent abuse on the part of builders in this respect, as they obtained considerable profit by letting the hoardings for advertising purposes, very much to the annoyance of the owners or occupiers of the adjoining property. The conference thought it would be very desirable that the prolonged continuance of hoardings should be avoided, and accordingly passed the following resolution: That, in the opinion of the conference, licenses for hoardings should be granted for a limited period only, subject to renewal at the discretion of the local authority, and that, if necessary, statutory provision should be made.

On the question of dust during the demolition of buildings it was felt that something should be done to afford the public better protection than they at present have from the nuisance so caused, and the conference passed the following resolution:

That, in the opinion of the conference, when demolitions take place in streets, the owner or contractor should be compelled to prevent annoyance as far as possible by sprinkling water and by the erection of reed or straw screens, or screens made of other suitable material, such regulation to be enforceable either on the information of the police or of any person suffering injury or annoyance.

Several local authorities have urged that some remedy should be found for the frequent opening up of public ways by water, gas, electric light and telephone companies. The conference considered that this constitutes a great evil, and is the occasion of much annoyance to the public generally, and frequently of loss to tradespeople, and therefore should as far as possible be prevented. It was suggested that the local authorities should have more power of control, and that subways should be constructed, when practicable, under the streets in which the pipes, etc., should be laid. The following resolutions were passed: That the conference is of opinion that in all new leading thoroughfares subways should be constructed in which the water and gas mains, pipes, etc., could be placed; that this conference is of opinion that the time has arrived for concerted action on the part of the local authorities of the metropolis to remedy the inconvenience, annoyance, loss of time and money now caused by the operations of gas, water, telephone and electric lighting companies in laying down, renewing, maintaining and repairing their mains, pipes, services and wires.

It was pointed out that frequently the whereabouts of public conveniences are not sufficiently indicated. The conference thought that something might be done to remedy this, and accordingly passed the following resolution: That, with a view to the better indication of the whereabouts of public conveniences, direction tablets should be fixed more numerously than at present in suitable prominent positions.

Asphalt Competition in Buffalo.

The first indication of competition between the branches of the Asphalt Company of America and independent companies appeared March 6 in Buffalo, when bids were received for constructing eleven streets from the American Contracting company, Henry P. Burgard and the Warner-Quinlan company. The Warner-Quinlan company bid on nine streets and received the awards for five, upon which it was the lowest bidder. The press of the city questioned the reality of the competition, an analysis of the bids showing that the old companies bid high on the streets which the new company secured, while the new company bid much higher on the streets awarded to others than it did upon those upon which it was successful.

Analysis of the bids by the city engineer shows, however, that there has been some reduction in prices. Other bids were received on March 15 for three streets, on one of which the Warner-Quinlan company was low bidder, on one the German Rock Asphalt company and on one the American Contracting company. On all the bids received

thus far this year the city engineer computes the average per square yard for the lowest bids at $2.52, when reduced to the same basis upon which it was computed that the average price last year was $2.65. This indicates a reduction in price of 13 cents a square yard. There is much variation in the price for individual streets, however.

These prices include grading, curbing, setting receivers and all incidentals. In the table of average prices last year, which appeared in Municipal Engineering Magazine last month, these items were eliminated, and the average price for foundation, binder and wearing surface was $2.20 per square yard. The difference between the averages for last year shows the average cost of grading, curbing, setting receivers and incidentals to be 45 cents for that year. If we assume the average cost of these items for the small number of streets bid upon thus far this year to be 45 cents also, we find the average cost of foundation, binder and surface so far this year to be $2.07. This seems to be a fair price. When the city of Indianapolis had actual competition, which was not of the cuthroat order to crush out a rival, this was about the price for the pavement computed on this basis for Indianapolis conditions. Careful estimate of the actual cost of an asphalt pavement under these conditions, with the price quoted for asphalt material, including guaranty and interest on capital invested, indicated that this figure gives a fair margin for profit.

The Illinois Central Railroad an Educator on Good Roads.

The Illinois Central railroad is doing some special work in educating the people along its line as to the possibilities and value of better roads. A train is to be sent north from New Orleans to Chicago to give object lessons in road building. At a number of places the train will stop and pieces of model road will be built. Arrangements will also be made for public meetings for discussing the matter of better roads. This is an enlightened procedure and is almost certain to ultimately return to the railroad company a good interest on the money and energy invested.

City Not Responsible for Cost of Changing Structures Under Streets.

An opinion was rendered by E. T. Price, city counsel at Newark, N. J., March 7, relating to the responsibility of the city for the alteration of gas pipes in the streets. The opinion also covers the liability of the city in regard to the cost for changing trolley tracks, railroad tracks, conduits in streets and all other appurtenances placed in them under franchises granted to corporations or private persons. The opinion is to the effect that the city has no responsibility where, by reason of changes made for the benefit of the public, property of others is interfered with. If the city changes the grade of a street for a reasonable purpose, any railroad tracks in the street must be changed to conform to the new grade, unless such change should destroy the franchise of the company. The same rule is to apply to trolley roads. Changes in pipes and conduits must also be made by the owners without compensation from the city.

The opinion was brought out in connection with the proposed construction of the central relief sewer, which, owing to extraordinard size, will necessitate the changing of telephone conduits and gas pipes.

Specifications for the Construction of Brick Pavements by the N. B. M. A.

The committee on specifications for construction of brick pavements of the National Brick Manufacturers' association, composed of D. V. Purington, W. P. Blair and T. B. Townsend, made the following report at the recent meeting of the association:

Your committee approached the consideration of the question involved in this resolution with considerable embarrassment.

Primarily these questions relate to matters pertaining almost exclusively to the work of civil engineers to whom falls the duty of preparing specifications and superintending their execution, and the manufacturer of brick has little to do with them. There are few civil engineers who will not admit that in an industry so comparatively new as that of brick paving it is possible for mistakes to occur or that there may be honest differences of opinion regarding the method of their construction.

The preliminary work of the committee was devoted to the manner any recommendation they might make should be presented. Indeed, your committee scarcely felt warranted in making recommendations, but simply desire to embody in this report the result of their experience and observation in the form of suggestions and, if possible, to do this in a manner that shall in no way reflect upon the position previously taken by any of the engineers. Your committee, however strong in their own convictions, do not expect absolute unity of opinion when such diverse conditions exist as is the case throughout the United States where brick are used for pavement; but they do believe that the time has arrived when a few cardinal principles should be definitely settled and a uniformity upon certain lines be adopted.

The drawing of specifications for a number of years has furnished a fertile field for theoretical thought, and it has sometimes seemed that those engaged in the work endeavor to get up a plan a little different from any one else.

The members of your committee happen to represent the three states in which more paving brick are made and used than any other in the United States, and have all been

engaged in the manufacture of this material. Two of them, in addition to being manufacturers, have been contractors for the laying of pavements and all of them interested in having the best possible pavement that can be made from good brick.

With these preliminaries before you (with profuse apologies for any seeming interference with their work to the engineering fraternity) your committee respectfully, but sincerely, submit the following suggestions as embodying the results of their best judgment and experience:

First—For all streets in cities or large towns a concrete foundation of broken stone and cement of not less than six inches in depth shall be constructed with the surface to conform precisely with that of the finished street. Upon this concrete foundation shall be placed not less than two inches of clean sand, entirely free from pebbles. Preceding the laying of the brick upon this cushion at either side and next to the curb, should be placed a board one inch in thickness to the hight of the brick to be set in the street. This board should remain until after the brick are rolled, when it should be displaced and in its stead the place should be filled two-thirds with pitch, the remaining one-third should be filled with sand.

The brick when placed upon this sand cushion should be rolled with a roller not exceeding five tons in weight, and one rolling should succeed another until the brick are brought to an even surface and the sand cushion thoroughly compacted.

Your committee have very decided convictions in regard to the use of the heavy roller and are satisfied that it is almost impossible to secure uniformity in the surface and uniformity of compaction of the cushion by the use of a roller heavier than mentioned. They do not think it necessary and particularly emphasize this, as but few specifications for brick pavement closely adhere to this requirement.

The work thus far being accomplished, no accumulation of dirt should be allowed to remain on the surface of the brick or in the crevices between them preceding the filling of same with a mixture of cement and sand, which shall be in proportion of one to one. This cement filler must be skillfully applied and requires more attention in its minutest detail than any other portion of the construction.

The cement and sand must be thoroughly mixed dry, and kept in continual motion from the time the water is being applied until it is swept thoroughly into the crevices of the pavement. It must be mixed so thin that all interstices are completely and perfectly filled. This done and left absolutely without interference by use or travel until the filler has become thoroughly set, we have our ideal brick street complete in satisfaction, and in durability unquestioned and unmeasured.

In outlying residence streets in our cities, in towns and villages where the travel is lessened from two thousand and over to five hundred and less daily, such communities can enjoy the luxury of a very satisfactory street lasting a lifetime at much less cost. So that where the travel is reduced, four inches of concrete is sufficient, or where gravel can be had at a minimum cost, a foundation of gravel with a road bed properly drained, with sand cushion and sand filler, will be found very satisfactory. In the construction of country roadways a course of good brick laid flat upon a bed of three inches of gravel and sand is very desirable where difficulties to drainage obtain and cheap construction is wished for.

As we have intimated, it is not our purpose to recommend to this convention a specification in detail for the construction of brick streets.

That is scarcely possible to do and make it apply equally well to all the varied conditions with which we meet, but this committee feels that it cannot do better than refer to the paper read before this convention one year ago by Engineer George B. Grimes, as embodying the best details for the construction of brick streets.

These details skillfully applied have furnished conclusive proof of the best and most durable construction that has come under the notice and examination of your committee.

After considerable discussion of the effect of such action the meeting adopted the following resolution:

Whereas, This convention has listened to the report of the committee on construction of brick streets with satisfaction, and fully approves of same, and,

Whereas, The American Society of Municipal Improvements has appointed a committee to act cojointly with a like committee on construction of brick streets from this association, and,

Whereas, A committee of this association known as the testing committee has notified the convention that they will not be ready with a full report before June, 1901, and

Whereas, It is the sense of this association that the best interests of both the buyers and sellers of paving brick will be promoted by the insertion in all contracts for the sale of same a provision requiring that the brick shall be inspected at the maker's works by engineers or other competent persons of high character, who will be disinterested and mutually satisfactory to both buyer and seller,

Be it therefore resolved, That the committee on the construction of brick streets be continued and enlarged to consist of nine members (six additional members to be appointed by the president), whose duty it shall be to arrange a joint meeting of the several above named committees, the duty of the joint committee to be to adopt and issue complete specifications for the construction of brick streets in detail, and the same shall be promulgated by and with the authority of this association, and recommended to all members of the same for adoption and use in their business; and that the members of the joint committee are hereby also requested and instructed to use their best endeavors to bring about the insertion of the provision for inspection at makers' works, as above set forth, of all contracts for paving brick to be hereafter sold by any of the members of this association.

A. N. Talbot, W. K. Eldridge and A. D. Thompson are the committee of the A. S. M. I. referred to.

Oil for Streets.

A. E. Brock, Trustee of the City of Redlands, reported to the California League of Municipalities his success in the use of oil upon streets:

It has in fact settled the question of dust with us. Two years ago, when we adopted the plan, water was very scarce, and that moved us to try the experiment of using oil. We had not a single complaint from any person in the town in regard to the use of the oil. It has satisfied everybody much better than water, and, what is one of the best features of it is, that when the rainy season comes it protects our roads and keeps them in better condition than would otherwise be the case by putting a coating upon the streets. One objection that was raised to it was its effect on ladies' dresses and bicycles. But all of those objections have been practically settled. There is nothing whatever detrimental in the use of oil on the streets, and the more we use it the more we think of it. There is no doubt that we will continue to use it instead of water. The oil must be heated and must be put on hot. It is applied with a patented machine six feet wide, and on top of it the machine puts a little dust—it works better where there is about an inch of dust on the street. It should be put on in hot weather as it runs better and spreads out. Then in a day or two it can be driven over. At first we applied it on one side of the street and put up barriers so as to keep people off, but now we let them drive over it if they wish. It will stick on the wheels of a wagon for a day, but after that it is not noticed. Three times sprinkling a year will keep the dust down. It is not applicable to an asphalt street, as it would spoil the asphalt.

We paid one year $4,424, including $15 a mile royalty for the use of the machine on a total of eighteen miles of street, and the sprinkled space was eighteen feet wide on some streets and on some twelve feet wide, the sprinkled area being 95,000 square feet.

A poor grade of oil with an asphaltum base is used, costing $1 to $1.25 a barrel. The total cost of the sprinkling for the width of street served was 8 cents a front foot on each side of the street, of which the property-owners cheerfully paid 2 cents.

The only objection to the use of oil in the Berkeley park system was the rank odor, which lasts from four to six weeks.

A Family Eminent in the Asphalt and Coal Tar Industries of America.

So much has been said on the subject of the use of bituminous cements and concretes and so little has been said by those who have taken an active part in their use, that Mr. Fred J. Warren has been requested to write for Municipal Engineering some articles on the subject. His qualifications for the discussion of the subject will certainly make these articles of much interest.

Mr. Warren's special equipment in the matter arises from the fact that he is one of the family of Warrens who first distilled and used coal tar bitumen in the United States, and were among the first importers and refiners of asphalts, and has had long association in business with the best minds devoted to the subject.

Mr. Samuel M. Warren, now of Brookline, Mass., in 1845 was engaged in the business of laying pine tar roofs, and coal tars at that time were the waste products of the gas works. He conceived the idea of using coal tars to mix with pine tar pitches, and almost immediately thereafter used coal tar for saturating dry felt in making roofing paper. The first experiments and use occurred in Cincinnati. Mr. Warren was then a young man, and the opportunities for the development seemed so great that his brothers, John Warren, Cyrus M. Warren, Herbert M. Warren and E. Burgess Warren, successively and almost immediately entered with their brother upon contracting systematically for the largest supplies of tars in the United States. The various brothers controlled at one time the tars produced in Cincinnati, St. Louis, New York City, Philadelphia, Baltimore and Washington, D. C.

To John Warren, who located in Buffalo, N. Y., is entitled to the credit for first distilling coal tar and making coal tar pitch; and its immediate substitution for pine tar spread over the United States. Hendricks's Architectural, Engineering and Mechanical Directory of the United States gives names and addresses of over seven thousand concerns now actively engaged in the laying of this kind of roofing. The business was almost immediately so prosperous that out of the revenues Messrs. Cyrus M. Warren and Samuel M. Warren took courses in Harvard college, the latter afterward being professor of organic chemistry in the Massachusetts Institute of Technology, and the author of that part of Dana's work on hydrocarbons which appeared in Dana's work on mineralogy.

When petroleum came on the market the Warrens were among the first distillers in the United States, and Mr. Cyrus M. Warren became recognized as the best authority on the use of bituminous materials and invented the process of fractional distillation of petroleum and coal tar oils, which process has given to the world all the numerous by-products. The commercial growth of the business up to 1870 was phenomenal and all of the best energies were necessarily applied to the commercial development rather than to scientific investigation. In 1870 reverses came and found the Warrens with large contracts for tar, with a falling market and increased competion on the price of tar and manufactured goods. The reverses were so great that in 1876 they were, with the exception of E. Burgess Warren of Philadelphia, in an embarrassed condition.

At this time competition made necessary the development of something new and better, and Cyrus M. Warren invented the as-

phalt roofing which has so long been manufactured by the Warren Chemical & Manufacturing company, and they became the first large importers and refiners of asphalt in this country.

The early failure of the coal tar bitumens in concrete construction, owing to the price at which they were laid, furnished no incentive for development, and a general view prevailed that concretes in which coal tar bitumens were used were deficient in every respect and should be excluded from all standard specifications. A monopoly in the control of asphalt made it commercially profitable to decry even the best coal

FRED J. WARREN.

tar bitumens and to extend the use of asphalts. Yet it seems to be a fact that the early asphalt pavements were as great failures as the early coal tar pavements.

In recent years the Warrens have played a prominent part in the development of the asphalt pavements of the country. Mr. E. Burgess Warren was one of the organizers and one of the largest stockholders of the Barber Asphalt Paving company, and for many years its vice-president. Cyrus M. Warren was the organizer and the president of the Warren-Scharf Asphalt Paving company, and in the management of this company and of the Warren Chemical and Manufacturing company and other allied interests he was aided by his brothers, sons and nephews, and there have been engaged in the business over twenty-two Warrens.

Mr. Fred J. Warren is one of eight brothers who have given their time to the business and have furnished to the trade the late Jesse Warren, the first general superintendent of the Barber Asphalt Paving company, who continued in that position until his retirement on account of ill health; Henry J. Warren, superintendent of the Barber Asphalt Paving company in Buffalo, N. Y., who has personally superintended over $10,000,000 worth of asphalt paving; George C. Warren, general superintendent of the Warren-Scharf Asphalt Paving company, and Herbert M. Warren, superintendent of the Barber Asphalt company's refinery in Philadelphia. They are all sons of the late Herbert M. Warren, who was the first distiller of coal tar in St. Louis and Philadelphia and who was one of the organizers of the New England Felt Roofing company and the Warren Chemical and Manufacturing company, and was at the time of his death vice-president and active manager of that company.

Mr Fred Warren himself was first connected in the business as clerk and laborer for the Warren Chemical and manufacturing company in their refinery in New York, in 1883, and in 1884 was connected with the laying of Alexander-st. in Rochester, N. Y., the first pavement laid by the Warren-Scharf company. On account of ill health he went West in 1885 and became connected with the Barber Asphalt Paving company as foreman and then as assistant superintendent in St. Joseph, Mo., in 1886. In 1887 and 1888 he was superintendent of that company in St. Joseph, Mo., and Omaha, Neb. In 1889 he was transferred to Chicago as superintendent of the company's business there. On account of ill health he moved to Denver in 1890, where he took an active part in the introduction of asphalt pavements in that city, and had personal supervision of all the pavements laid by the Barber Asphalt Paving company there. In 1892 he was one of the organizers and the manager of the Colorado Paving company, manager of the Colorado Paving company, in which the Barber company was interested. Owing to the distance from Eastern points his company maintained a separate laboratory for the examination and preparation of the pavements. In 1898 on account of the ill health of his wife he returned to Newton, Mass., the place of his birth, and immediately started in laboratory work, and has been following out a line of independent chemical research during the past two years.

Mr. Warren's father died in 1880 before the paving business started to develop, and he and his brothers from necessity put their time upon the practical and construction end of the business, while other branches

of the Warren family developed the business and financial end. The various brothers have personally superintended the construction of over 30 per cent. of all the asphalt pavements now in use in the United States. The knowledge attained by long family intercourse with those who have given their lives to the development of the bituminous industry of the country and from being familiar in a business way with the best thought of Professor Bowen, Richardson, De Smet, Scharf, Dow, Miller and others, is not generally at the command of writers upon this subject.

Mr. Warren's recent investigations have been largely upon the line of developing new uses for bituminous concretes, and the development of new methods under which improvements can be brought about. He is in no way interested in the use of asphalt for street pavements, and in fact all of the Warrens with a few exceptions have gone out of the business except on the lines above mentioned.

The Venezuelan Asphalt Case in Court

The controversy between the Warner-Quinlan Company and the National Asphalt Company has been submitted to the Venezuelan courts for adjustment. The Warner-Quinlan claimants sent a few workmen on to the lake claimed by the Bermudez company; they were ejected and suit was begun against the Bermudez company before the Bermudez courts. It is the intention of the state department to let the controversy be tried out before the Venezuelan tribunal.

Cost of Cleaning Water Mains.

To the Editor of Municipal Engineering:

Sir—In your magazine for December, page 428, referring to the cost of cleaning water pipes with mechanical scrapers, you quote a statement of mine showing the cost per foot of cleaning different pipes. In each case the cost is put down at cents per lineal foot, while it should be hundredths of cents. As the difference is considerable, I would suggest that it be corrected, as the information contained in your article has attracted considerable attention among water works officials. Yours truly,

F. W. W. DOANE,
City Engineer of Halifax, N. S.

Cost of Municipal Lighting in Massachusetts.

The report of the Massachusetts gas and electric light commissioners for 1900 shows that seventeen towns and cities in the commonwealth own and manage their own lighting plants. The towns and cities are: Belmont, Braintree, Chicopee, Danvers, Hingham, Hudson, Hull, Marblehead, Middleboro, Needham, No. Attleboro, Peabody, Reading, Taunton, Wakefield, Wellesley and Westfield. Three towns, Middleboro, Wakefield and Westfield, furnish gas and electricity, the others electricity only. Belmont, Hingham, Needham and Wellesley have only distributing plants, buying their electricity. The town of Westfield bought the private plant in that town for $150,000 and began to supply June 1, 1900. The total assets of these municipal lighting plants are $1,415,269.95. The maximum number of lamps is 2,627, ranging from 1,200 to 2,000 candle power. The maximum number of incandescent lamps is 38,450.

The cost of municipal lighting is figured by the board as follows: To interest, depreciation and other cost items is added the net cost of operating. The net cost is the difference between the operating expenses and the income from commercial and domestic lighting. Interest is computed at the rate paid on bonds and notes and depreciation at 5 per cent. upon the cost as shown by the books. It will be noticed that the rates secured in most cases are very much less than are obtained elsewhere under private ownership. Belmont has 12 arc and 146 incandescent on moonlight schedule, 5.5 hours in 22.4 days per month. Cost, $121.11 for arc and $30,28 for incandescent per lamp year.

Braintree has 111 incandescent and 94 arcs, run 7.7 hourse, 24.8 days; cost per lamp per year is $22.48 for incandescent and $89.91 for arcs.

Chicopee has 143 arc run 8.7 hours 28.8 days; cost per lamp year is $109.74.

Danvers has 123 arcs, run 5.9 hours, 24.6 days; cost per lamp year is $55.87.

Hingham has 379 lamps of 32 candle power, run 5.2 hours for 25 days; cost per lamp year is $15.86.

Hudson has 25 arcs and 106 incandescent, run 4.8 hours for 28.7 days; cost per lamp year is $22.88 for incandescent and $132.08 for arcs.

Hull has 214 incandescent, run 4.7 hours for 24.6 days; cost per lamp year, $60.18.

Marblehead has eight 30-candle power, ten 16-candle power, 41 25-candle power and 154 arcs, run 8.6 hours 29 days; cost was $17.72 per lamp year for the 30-candle power; $9.42 for the 16-candle power, $14.75 for the 25-candle power and $68.75 for the arcs.

Peabody has 15 lamps of 32 and 50-candle power and 178 arcs, run 10.2 hours, 30.4 days; cost of lamps per year is $27.81 and $43.54 for the incandescent and $73.75 for the arcs.

Reading has 128 arcs run 5.3 hours for 24.1 days; cost per lamp per year is $89.65.

Middleborough has 152 incandescent and 15 arcs, run 4.4 hours for 24.1 days and 13 arcs eight hours for 24.1 days; cost per lamp year is $25.62 for the incandescent and $102.47 and $186.31 for the arcs.

Needham has 380 incandescent, run 4.9 hours for 24.3 days; cost per lamp year is $11.94.

No. Attleboro has 588 incandescent, run

4.3 hours, 24.2 days; cost per lamp year is $10.96.

Taunton has 206 arcs, run 6.9 hours, 25.9 days; cost per lamp year is $73.12.

Wakefield has 145 arcs, run 4.7 hours, 24.2 days; cost per lamp year is $83.30.

Wellesley has 18 16-candle power lamps run 12.8 hours, 30.4 days, and 535 25-candle power lamps, run five hours, 25.5 days; cost per lamp year is $16.85 for the 16-candle power and $8.63 for the 25-candle power.

Westfield has seven incandescent and 89 arcs, run 5.5 hours, 30 days. Report is for one month only, but it shows a gain on operating account of $488.04 for that time. The town has customers for 12 arcs and 421 incandescent lights, and the development of this municipal enterprise will be watched with great interest.

The prices charged private customers by those municipal plants are low. Belmont, Hudson, Taunton and Wakefield charge a cent an hour; Braintree, 6 mills; Danvers, 5 mills; Hull, 1¾ cents; Middleboro, North Attleboro and Peabody, three-fourths of a cent; Reading, 1½ cents; Westfield, $1 to $1.25 per month.

Municipal lighting plants are contemplated by a large number of towns and cities throughout the state.

City Sustained in Refusal to Permit Erection of Poles.

A decision was rendered by Judge McCann at Dayton, O., March 19, dismissing the application of the Dayton Electric Light company to erect two poles in the southeast corner of Fourth and Main-sts., in front of the Davis office building. Judge McCann held that the plaintiff's right to make the appropriation sought depends not only upon the general consent to use the streets as obtained in its franchise, but also upon consent of the proper authorities to locate its poles and tear up the streets at the points named. The plaintiff did not establish the right to make application inasmuch as the city officials had refused to grant permission to erect the poles and excavate the streets, and a dismissal was decreed.

The city boards decided some time ago that hereafter no poles shall be placed in the district bounded between the river, Sixth-st. and Webster-st. The outcome of the case will, therefore, prove of interest to the city, establishing ash it does a precedent in the matter of erecting poles in the underground district.

Appropriations for Public Work in Washington.

The District of Columbia appropriation bil passed by congress appropriates $500,000 to continue work during the next fiscal year on a filtration plant for Washington; $162,000 for the completion of the Washington aqueduct tunnel and the Howard University reservoir; $375,000 for a sewage disposal pumping station; $340,000 for new sewers. The bill to permit the laying of a single track for an electric railroad across the aqueduct bridge did not pass.

Destruction of Landmarks.

A circular to commissioners of highways has been issued by County Surveyor W. M. Hay of DeKalb county, Illinois, calling their attention to the frequent displacement and complete removal of stones set in roads to mark sections and other land corners. He requests their co-operation in impressing the value of their landmarks upon those who do the actual work of road repair, especially those running road graders and scrapers, suggesting that the commissioners hold them responsible for such destruction of marks. The destruction of corners makes additional work for surveyors and additional fees so that Mr. Hay cannot be accused of self-interest in issuing this circular. Other county surveyors may arouse some interest in the matter by similar action. Doubtless Mr. Hay will send copies of the circular to any one interested if he is addressed at Sandwich.

Engineers' Headquarters at Pan-American Exposition.

The Engineers' Society of Western New York decided, at a meeting held March 5, to invite all the engineers' societies of the two Americas to partake of its hospitality during the Pan-American exposition. A bureau of information and postoffice will be provided the visitors in the Ellicott square headquarters.

A Million Wanted for Good Roads in New York.

At the recent good roads convention held in Albany, N. Y., a resolution was adopted asking the legislature to appropriate $1,000,000 for road construction during the next fiscal year. The convention was composed of nearly two hundred supervisors, sent as delegates from the different counties of the state. State Engineer Bond stated that in the course of the last year fourteen roads had been built in nine counties, with a total length of 35.17 miles, at a cost of $226,213.04. Also that nine roads in five counties are now under course of construction, with a total length of 18.41 miles, at a cost of $162,952.82.

The state appropriation last year was far below the amount appropriated by the counties thus resulting in absolutely no road improvement in certain parts of the state, where the taxpayers are willing to pay their one-half.

The discussion at the convention indicated that it was the prevailing opinion that roads leading out of cities should be macadamized with a traprock surface, which

costs on an average of $7,977, and that side roads need only be built of dirt at an average cost of $2,053.

Indiana Improvement Laws of 1901.

The Indiana Legislature enacted new laws pertaining to street improvements and assessments, sewers, gravel roads, etc., during the recent session as follows:

—Street Improvements—

House act No. 35 expressly repeals the "Barrett law" so far as it applies to cities organized under the general law, and substitutes another mode of making street, alley and sewer improvements in such cities. It requires that the assessment of benefits against any land benefited by such an improvement shall be made on the basis of the special benefits peculiar to the property assessed, as distinguished from general benefits to the city at large, and that the assessment shall be made after notice to the property-owner, and after he has had an opportunity to be heard. An appeal from such assessment lies to the Circuit Court, and the assessments as finally determined shall be collectible in ten equal annual installments, with interest at 5 per cent., in the same way that taxes are collected. Bonds may be issued to anticipate the collection of such assessments.

—Street Assessments—

House act No. 336 amends acts 1899, page 58, by which it was provided that no action should be brought for the enforcement of any lien or assessment for public improvements until after ten day's notice should have been given the owner of the land of the assessment and of the amount due, with interest, and where the owner has executed a waiver or contract entitling him to pay his assessments in installments under the provisions of the Barrett law. The act contains an emergency clause.

—Sewers—

Senate act No. 124 authorizes any incorporated town in the state to build sewers or a system of sewers for sanitary or drainage purposes within the corporate limits of the town, and outlets to any neighboring stream or water course at the expense of the property benefited thereby, or at the expense of the town. After the board has adopted resolutions giving a general description of the work intended, with its beginning, route and terminus, and has caused it to be surveyed, it shall cause notice to be given by publication or posting of the time of hearing the report of the engineer. A two-thirds vote of the board is necessary to determine that the proposed work is of public utility, and to adopt the report. An appeal lies from the board to the circuit court. When the work is determined on it is to be done by contract. The act contains an emergency clause.

House act No. 287 is supplemental to acts of 1895, page 190, on the subject of sewers in cities organized under the general law. It provides that the common council of any city or board of trustees of any town shall have power to construct and maintain sewers along any street or alley or part thereof, or along or across any lots, or the right-of-way of any railroad or electric or traction road within such city or town, and shall be the sole judges of the necessity or utility of such sewer. They receive power to condemn any lot or part of a lot or any unplatted lands or the right-of-way of other lands, of any railroad, person or corporation, either within or without the corporate limits of the town or city. The act contains an emergency clause.

—Gravel Roads—

Senate act No. 53 makes the board of commissioners of each county a board of directors for all free gravel, macadam and free turnpike roads in such county, and imposes on them the duty of dividing such roads into three districts as nearly equal as possible, one of which shall be taken charge of by each commissioner. Superintendents for such roads are to be appointed on the basis of one superintendent for not less than ten miles nor more than fifteen miles of road, who shall have charge of keeping such road in repair under rules adopted by the board. Provision is also made for condemning materials to use in repairing such roads by proceedings before the board of commissioners subject to an appeal to the circuit court.

House act No. 221 exempts certain gravel roads of Randolph county from the operation of act 1899, page 26, by which the issue of bonds for the construction of free gravel or macadamized roads was limited to 4 per cent. of the total assessed taxable valuation of the property of the township or townships in which such road might be located.

Senate act No. 134 provides for the construction and maintenance of free gravel roads by the county commissioners of any county upon the petition of fifty freeholders who are voters of the township or townships in which the road is to be located. The act applies to townships containing cities, if such cities have less than 30,000 inhabitants.

A Chicago Pavement Fire.

A half block of pavement on Halsted-st., Chicago, was set on fire Feb. 28 through a peculiar circumstance. An oil tank was wrecked by a trolley car, the oil flooding the street pavement. Another electric car came along and a spark ignited the gas from the fluid, the flames spreading rapidly. The car which caused the original trouble was blocked by the wrecked wagon and, being unable to escape, was burned to

the wheels. The flames spread to a store, burning the woodwork and ruining the plate glass windows. The arrival of the fire department saved other property by confining the burning oil to the middle of the street, where it burnt itself out. All of the windows on both sides of the street for half a block were shattered and the paint on the buildings ruined. The loss was $4,000.

Supreme Court Sustains Right of Illinois Cities to Change Water Rates.

The United States Supreme Court rendered a decision March 26 in favor of the city of Chicago in an issue where the city sought to reduce rates for service and the Rogers Park Water Company to maintain their own figures. The decision affects the water systems of Freeport, Danville and Rogers Park. In each case the water companies contended that the law of 1872 and other subsequent acts authorizing contracts for water supply for thirty years, included the right to fix rates for that time and that the rate once fixed could not be changed. The Illinois supreme court sustained the municipalities in each case, holding an ordinance reducing the price of water to be valid. The United States Supreme Court confirms the decision of the Illinois Supreme Court.

Court Declares Proposed Chattanooga Water Rates Unreasonable.

A decision was handed down Feb. 23 by Judge Clark in the United States district court of Tennessee, in which he held that the ordinance passed by the city council of Chattanooga in 1897, providing for what they believed was a reasonable tariff of water rates, is invalid. In the opinion of the court the rates provided are unreasonable. Judge Clark holds that the city may regulate water rates, but the regulation must not be such as to jeopardize the investment of the water corporation, which is entitled to a reasonable profit on its investment.

A Wisconsin Court Declares Minimum Meter Water Rate Invalid.

A decision was handed down by Judge Kirwan, in the Circuit Court of Manitowoc, Wis., March 4, in the case of Henry Vits vs. the Manitowoc Water Works company. The plaintiff had a meter and refused to pay for more water than was actually used. The company shut off the water and the plaintiff brought suit to compel the service and for damages. The court sustained the plaintiff, holding that the consumer is liable for only actual consumption where a meter is used, even though a minimum rate be stated in the franchise given the company. The decision affects hundreds of patrons in the city. The minimum rate is $5, which the company insists upon collecting regardless of the amount used according to a meter. Action will probably be taken by a number of patrons to recover. The company will appeal.

Trouble Again Reported with Ashland Water Supply.

An analysis of sand taken from the filter used by the Ashland Water company, Ashland, Wis., was made by Dr. H. L. Russell of the University of Wisconsin recently. Dr. Russell said that white rats were inoculated with broth cultures made from the respective samples of sand. The rats inoculated with scraped sand died in twenty-four hours. An examination of the filters at the pump house of the water company revealed the fact that the sand which is used to purify the water has not been changed in three years. The intake pipe has its opening immediately approximate to a point where the main sewers empty. A typhoid fever epidemic has existed in Ashland for three months, resulting in twenty-two deaths. From Jan. 1, 1901, to Feb. 27 there have been 283 cases of typhoid fever in the city, and the contagion is not decreasing.

Proceedings have been begun in the circuit court for the purpose of recalling the company's franchise.

Hempstead Special Election for Water and Light Plants Illegal.

The New York supreme court decided that the special election held last October by the village of Hempstead for the purpose of raising $100,000 for purchasing or contracting municipal water works and electric light plants was illegal. Judge Garrettson, who handed down the opinion, contends that the question of light and water plants should have been presented to the voters separately, and not together, as they have been at each of the three previous special elections held for this purpose. Of these elections two have been held illegal because they had not been advertised the specified number of days required by law, and the question of water and electric lights was voted down the third time. Another special election will be necessary now if the village still desires municipal ownership.

Who Shall Operate the Municipal Lighting Plant in Columbus, O.

A decision was rendered by Judge Williams, March 11, in a suit brought against the city of Columbus, O., by Linas B. Kauffman, director of public improvements, and others, to compel the city to continue the operation of the electric light plant. Judge Williams said the question of issue was the respective powers of Linas B. Kauffman and the board of trustees of the electric works of Columbus. The ordinance passed by council authorizing the issue of $68,000 bonds, also authorized the director of pub-

improvements to establish an electric light plant. This was done and the plant was placed in operation and continued until July 5, 1900, when Director Kauffman discontinued the operation of the plant because sufficient funds had not been provided. A board of trustees was then appointed. Judge Williams said that the charter law clearly provided that the director of public improvements shall have supervision and control of the lighting of streets. The amendment of 1898, empowering the city councils to purchase or erect electric light plants, did not affect or qualify the authority of the director of public improvements, and for this reason he could not turn the plant over to the trustees selected by the city council. The amendment of 1898 did not apply to electric light plants then in operation. The pleadings show that the city council failed to provide funds. But for this fact, a mandatory order to the director of public improvements commanding the director of public improvements to operate the electric light, would be warranted by the circumstances of the case. If the council has not, by a vote of three-fourths of all the members elected thereto, waived the exaction of any liability from the bondsmen of Kauffman for debts contracted by him beyond the amount appropriated, he cannot be compelled to operate the plant.

Engineer Brings Suit for Libel.

Suit was filed against the members of the water board of Lynn, Mass., March 4 by Charles W. Gay, former city engineer, for libel. Mr. Gay took exception to a statement of the water board regarding work he had done for it. The statement relates to a plan on file at the office of the water board, bearing the following title:

A hydrographic map of the territory draining into Saugus river prepared from a trigonometric survey and authentic compilation. C. W. Gay, C. E., Lynn, Mass., 1885.

The statement is as follows:

The only plan that the water board ever had of the water sheds of the Saugus river was made in 1885, for which the city paid the sum of $568, and besides showing the water sheds, it showed a table of the area of those water sheds. According to the figures on that plan the area of the water sheds above Howlett's dam, upon which the city paid water damages for diverting the water, is 15.322 square miles, while the true area, as calculated from the same plan, is only 10.868 square miles. By reason of this error of this plan, the city has paid water damages on 15.322 square miles when damages should have been paid on only 10.868 square miles.

Mr. Gay demanded a public retraction, which the board did not make.

Individual suits are filed against the five members of the board, W. B. Littlefield, president; James Burns, S. W. Dearborn, Thomas T. Nichols and Charles E. Spra[illegible].

Bricks of Bridewell Manufacture Recommended for Chicago.

A plan has been recommended by L. E. McGann, commissioner of public works at Chicago, which provides for the use of Bridewell bricks for city sewers. He estimates that by increasing the capacity of the plant at the house of correction, 8,000,000 of the 20,000,000 bricks required this year for sewer construction can be furnished at a rate from $1 to $2 less per 1,000 than the city is now paying. Plans are being prepared for enlarging the size of the Bridewell plant.

A Denver Storm Sewer Assessment Illegal.

The Colorado court of appeals rendered a decision March 11 in a suit instituted by tax-payers in the Broadway storm sewer district against the city of Denver, Col., to annul the assessment ordered by the city against the real estate of the plaintiffs for the construction of the storm sewer. It was alleged that the sewer enactment was unconstitutional because it was improperly advertised by the board of public works. An injunction was asked for in the district court restraining the city from enforcing the tax, which was denied. An appeal was taken with the result that Judge Thompson reversed the judgment of the lower court, holding that the entire assessment was illegal.

Riparian Rights Not of the Nature of Franchise.

The New York Supreme Court has rendered a decision in the case of the Niagara Falls Hydraulic Power & Manufacturing company, which brought suit to secure a reduction of valuation of their property for purposes of taxation. The company sought to reduce the assessor's valuation from $825,000 to $337,000 on the construction that its right to take water for the development of power was in the nature of a franchise and therefore not taxable. Judge Childs of the Supreme Court decided that "the relator's right to the use of the water arises from their ownership of riparian rights; that is to say, its ownership of real property which is subject to tax." He also ruled that "the assessment of the said property for the year 1900 in question shall not be reduced, and that the relator's writ should be quashed and set aside with costs to the defendants.

The decision creates a precedent for the valuation of riparian rights after works for the development of power have been built.

Award of Baltimore Garbage Contract Sustained.

A decision was rendered by Judge Ritchie, of the Circuit Court of Baltimore, Md., March 8, in the suit of Roscoe M. Packard against Samuel A. Rice. Mr. Packard, as a

tax-payer, instituted suit to prevent the award of a contract to the defendant for collecting garbage and other refuse in Baltimore for ten years from June 1, 1901. Mr. Packard alleged that the contract was awarded to Mr. Rice on a plan submitted on Nov. 24, 1900, although the bids were opened three days before that date; that Mr. Rice had no right to use the plan proposed by him, which is patented; that the bids submitted by Mr. Rice and Michael F. Horner were identical and showed unmistakable signs of having been prepared by the same person; that the American Contracting and Mfg. Company should have been awarded the contract as the lowest responsible bidder in accordance with the specifications.

Judge Ritchie finds that Mr. Rice's bid is in proper form and that his failure to file the plan in question is not a valid objection to his bid.

Technical Meetings.

The annual convention of the National Electric Light Association will be held at Niagara Falls, N. Y., May 21 to 26.

The 151st meeting of the American Institute of Electrical Engineers was held in New York City Feb. 28. Wm. J. Hammer delivered a lecture upon "Important European Electrical and Engineering Developments at the Close of the Nineteenth Century."

At a meeting of the Engineers' Club, Columbus, O., March 2, Assistant City Engineer George M. Lilly spoke on "Sewer Maintenance in Columbus."

The annual meeting of the Association of Ontario Land Surveyors was held at Toronto, Ont., Feb. 26, 27 and 28. The program included the following: "Surveys and Plans for Municipalities," H. J. Bowman of Berlin; "Topographic Photography," J. N. Wallace of Hamilton. Officers were elected as follows: President, James Dickson, Fenton Falls; vice-president, W. R. Aylsworth, Belleville; secretary-treasurer, Villiers Sanky, Toronto.

The Union Electrical Contractors' Association of New York state have decided to issue a call for a meeting at the Builders' Exchange building in Buffalo, July 17, for the purpose of forming a National Electrical Contractors' association.

Cost of Making Portland Cement.

In discussing the materials for making cement, which are available on the Pacific coast, Prof. I. C. Russell says:

"The cost of a Portland cement plant in Michigan which is capable of producing 1,000 barrels of cement per day is said to range from about $330,000 to $350,000. A smaller plant than this is not considered economical. The cost of making a barrel of cement is variously stated, but it is probably about $1 per barrel in a mill that turns out 1,000 barrels a day. The marl used in Michigan does not require crushing. If limestone is used, as it would have to be in Oregon, it must be ground as fine as flour, which would make the expense of production greater than in Michigan."

Prof. R. C. Carpenter makes an estimate a few cents less, and shows that the greater the capacity the less the cost per barrel.

Mr. A. Hugo Cederberg, in describing a plant of his design, which is very nearly automatic and whose power transmission is by electricity, gives a detailed estimate of the actual mill cost of a barrel of cement when the mill is running at the rate of 2,000 barrels a day as follows:

Under proper management the cost per barrel at the rate of 2,000 barrels in this mill should be:

Quarrying	4.8 cents
Conveying to crushers	1.1 cents
Crushing	1.1 cents
Limestone crushed	6.6 cents
Mixing and drying	2.1 cents
Rawstone grinding	0.5 cents
Burning	18.1 cents
Coal grinding conveyor	1.3 cents
Clinker grinding	6.1 cents
Packing and loading	3.3 cents
Steam producing	5.9 cents
Generating power	1.7 cents
Office and general expense	2.5 cents
Analyzing expenses	0.6 cents
Total manufacturing cost	55.7 cents

These figures give a very large margin for repaires and accidents, etc., etc., amounting to nearly 3 cents per barrel.

Interest on cost and depreciation of plant must be added to this figure, and the cost of selling must be added to obtain the lowest price at which the cement can be sold without loss. This mill uses the dry grinding process of preparing the ordinary limestone and cement rock of the Pennsylvania cement region and the rotary kiln for burning.

The advantage of large capacity is shown from the reports of the German cement dividends, factories making 200 to 1,000 barrels a day declaring 3 to 10 per cent. dividends in 1899, while those making 1,500 to 3,000 barrels a day declared 15 to 40 per cent. dividends.

Gleanings from Municipal Reports.

Pawtucket, R. I., is a city with a population of 39,000. It owns a water works system which has cost $1,840,000. The receipts for the last fiscal year were $188,489.03, the expenditures for maintenance were $102,468.94, to sinking fund account $86,020.09. The city appropriated $20,000 for new construction, of which $19,681.14 was expended. Of the receipts $17,360 were from hydrant rentals of the various districts served the works, $2,045 for watering streets and $2,601 for other public purposes. Of the maintenance expenses $51,413.38 was for interest paid, the indebtedness being about

$1,300,000. A new filter is needed. The highway department expended $95,202.36, half being for maintenance, one-sixth on account of Main street widening, $7,028.47 for curbing and the remainder in sums ranging from $200 to $4,000 on various streets. The Sewer Department spent $36,415.61, about $27,000 for general construction and $9,500 for maintenance. Experiments on sewage purification are in progress, part of the sewage having been purified somewhat by filtration since 1894. Experiments on the septic tank show that 41.5 per cent. of the organic matter in the sewage is removed in septic tank, leaving a total residue on evaporation of 1.868 cubic yards per million gallons there deposited. Of this amount 0.878 cubic yards is destroyed by the septic tank, leaving 0.99 cubic yards per million gallons of organic and mineral matter to be removed by hand, at a cost of $0.459 per cubic yard, or $0.463 per million gallons of sewage. Experiments on bacterial filters are in progress.

The specifications under which the city of Garrett let the contract in March for paving Randolph street should secure a good and durable pavement even though the cheapest of the alternative foundations is used. See figures for successful bid on another page.

Personal Notes.

George Beck has been elected city clerk at Goshen, Ind.

James J. Sheehan has been elected city engineer at Everett.

Dr. D. C. Hawley has been elected mayor of Burlington, Vt.

Harry H. Lane has been elected mayor at Peekskill, N. Y.

Julius F. Frehsee has been appointed city engineer at Lockport, N. Y.

Daniel O. Frost has been elected water commissioner at Gloucester, Mass.

Prof. D. J. McAdam has been elected engineer of East Washington borough, Washington, Pa.

S. Cameron Corson has been re-elected borough engineer for the ensuing year at Norristown, Pa.

Lieut. G. W. Langdon has been appointed superintendent of the street department at Newburyport, Mass.

Edward H. Smith has been elected city engineer, and Stephen W. Dearborn water commissioner at Lynn, Mass.

W. E. Mott has been promoted to assistant professor in the College of Civil Engineering at Cornell University, Ithaca, N. Y.

W. Scott Matlack of Mt. Holly, Pa., has been appointed superintendent of the water and sewerage systems at Freehold, Pa.

Walter S. Reed has been appointed to fill the vacancy caused by the resignation of Mayor Benjamin P. Morris, of Long Branch.

Mr. Paul Doty has given up his position with the Grand Rapids Gas company, to accept that of general manager of the Detroit City Gas company.

Philip J. O'Connell was elected mayor at Worcester, Mass., in the special election called to settle the dispute resulting from the regular election, when a tie vote was cast for that office.

T. C. Turner has been elected city engineer at Oakland, Cal.

Edward H. Smith has been appointed city engineer at Lynn, Mass.

Abel H. Clark was appointed water commissioner March 18 at Auburn, N. Y.

George M. Fernald has been reappointed commissioner of public works at Portland, Me.

Abel H. Clark has been elected water commissioner at Auburn, N. Y., to succeed Sidney J. Westfall.

John W. Ellis, M. Am. Soc. C. E., has been elected president and manager of the Providence Gas company, at Providence, R. I.

Henderson W. Knott, chief engineer of the Imperial Electrical Supplies, Ltd., of London, is visiting the United States.

E. C. Slater, who was recently appointed city engineer at Conneaut, O., has resigned to accept a government position at Watervliet Arsenal, Troy, N. Y.

Howard G. Taylor of Portland, Me., has been appointed first assistant to George D. Snyder, city engineer at Williamsport, Pa.

Winslow T. Webber has established an office in the Tibbets block, Gloucester, Mass., for the practice of civil engineering.

Frank Hoge, C. E., Wheeling, W. Va., died suddenly March 16, aged 60 years. Mr. Hoge planned and built the 158-ft. stone arch bridge over Wheeling creek.

E. A. Kemmler was promoted March 18 to the vacancy in the city engineer's department at Columbus, O., caused by the resignation of John P. Force, second assistant engineer.

Horace Andrews, former city engineer of Albany, N. Y., read a paper March 19 before the Albany Institute and Historical and Art Society on the subject of "The Nomenclature of Albany's Streets."

Joseph P. Ord, who recently resigned as vice-president of the General Electric company, has become permanently connected with the firm of J. P. Morgan & Co.

Gilbert Wilkes, head of a firm of electrical and mechanical engineers, Denver, Col., died in that city March 11.

John P. Force, second assistant city engineer at Columbus, O., has resigned his position and will devote his attention to municipal engineering.

H. H. Windsor has resigned his position on managing editor of the Street Railway Review of Chicago, and has been succeeded by Daniel Royse, who has been associated with him for the last four years. Mr. Windsor will engage in organizing and constructing electric railways.

S. Whinery, M. Am. Soc. C. E., Mem. M. Am. Soc. M. E., M. Am. Inst. Min. E., recently acting president of the Warren-Scharf Asphalt company, has opened an office as consulting engineer, at 95-97 Liberty-st. New York ,City. He will devote his attention to municipal work, especially street paving, the development of water-power and of industrial enterprises, and railroads existing or prospective.

Charles F. Loweth, M. Am. Soc. C. E. of St. Paul, Minn., has been appointed engineer and superintendent of bridges and buildings

of the Chicago, Milwaukee & St. Paul railway, with offices at Chicago. Mr. Loweth succeeds Onward Bates, M. Am. Soc. C. E., who resigned to enter private business.

W. B. Patton was elected city engineer of Duluth, Minn., on March 12. Mr. Patton has filled the position of city engineer under several previous administrations. During his last incumbency of the position in 1896-6-7, he designed and began the erection of the municipal water plant.

A. H. Lighthall, C. E., was found dead in his room in the Bartholdi Hotel, New York City, Feb. 26. Mr. Lighthall was best known as a railway engineer and inventor, although he constructed sewerage systems for Mobile, Ala., and New Orleans, and at the time of his death was engaged in remodeling these systems. Mr. Lighthall when found held a check in his hand for $10,000 for a patent which he had recently sold to a railroad company.

A. J. Hammond, recently assistant engineer on the Vandalia lines, has accepted an appointment as city engineer of South Bend, Ind., the first under the new charter. Mr. Hammond comes well prepared for the work from several years' experience as city engineer of Frankfort, Ind., and other experience in sewerage and water works as well as in the construction and repair problems in railroad maintenace of way. He is a graduate of Rose Polytechnic Institute and a past president of the Indiana Engineers' Society.

Mr. Onward Bates, long engineer and superintendent of buildings on the C., M. & St. P. railroad, has resigned and is succeeded by Mr. Charles F. Loweth, C. E. Mr. Bates's experience of over thirty years has almost all been in the departments of bridges and buildings of such constructions and companies as the St. Charles bridge over the Missouri river, Eads bridge over the Mississippi river at St. Louis, Baltimore Bridge company, Cincinnati Southern railway, Edge Moor Iron company of Wilmington, Del., Pittsburg Bridge company. Since Feb. 1, 1888, he has been engineer and superintendent of bridges and buildings of the C., M. & St. P. railway, where he had full charge of design, construction and maintenance of bridges, culverts, buildings, water supply, etc., on a system growing since that time from 5,700 to 6,500 miles in length, building more than eleven miles of iron and steel bridges, and the culverts which made it possible to replace forty-four miles of wooden bridges with earth embankments. It has been the policy of the C., M. & St. P. railway to do all work on, over or under its tracks with its own employes, and the work of the bridge and building department being done by day labor, so that Mr. Bates has been at the head of a working organization with a pay-roll which has at times exceeded $100,000 a month. Mr. Bates holds an honorary degree of civil engineer from the University of Wisconsin, and is a member of the Western Society of Engineers, the American Society of Civil Engineers, the American Railway Engineering and Maintenance of Way Society, the Institution of Civil Engineering and of other technical associations. Mr. Bates expects to engage in private practice as an engineer and contractor with W. A. Rogers, recently engineer of permanent construction of the same railroad under the firm name of Bates & Rogers, with offices in Chicago.

MACHINERY AND TRADE.

A Statement from the New York Continental Jewell Filtration Company.

We are in receipt of a letter from the New York Continental Jewell Filtration company of New York City, with a request for publication, containing the following statement:

To Whom It May Concern:

It having frequently come to my notice that Ira H. Jewell, my son, is representing himself as identified with the 'Jewell filter,' manufactured by the O. H. Jewell Filter company, and with myself as financial backer, I find it necessary to publicly state that the said Ira H. Jewell has had no connection whatever with the O. H. Jewell Filter company since selling his stock interest therein over one year ago, and never with its successors in the filter business, the New York Continental Filtration company; nor has he any business relations with me of any description.

Any statements of his, or those of his representatives, that he is authorized to do business of any sort for the O. H. Jewell Filter company, or its successors as above, are unqualifiedly false and without foundation; and if made, are done so with the deliberate intention to deceive. Respectfully yours, O. H. JEWELL,

Western General Manager New York Continental Filtration Company.

We would call the attention of those interested in filters to the name of Ira H. Jewell's company, the I. H. Jewell Filter company, as it is so much like the O. H. Jewell Filter company as to be misleading. The I. H. Jewell Filter company has no connection whatever with the O. H. Jewell Filter company or the New York Continental Jewell Filtration company, nor with the Standard Jewell Filter, which we manufacture and sell, and the patents of which we control. Yours very truly,

N. Y. CONTINENTAL JEWELL FIL. CO.

The First Central Station Heating Plant on the Smead System.

The central station heating plant at Washington Court House, Ohio, which is now practically completed, is constructed by the Central Station Heating company of Cincinnati for the Washington-Smead hot water lines. The work was commenced Nov. 26, 1900, by Mr. Isaac D. Smead, assisted by his son, Burton A. Smead. The boiler constructed for this plant under Mr. Smead's stand pipe system, as a whole, is

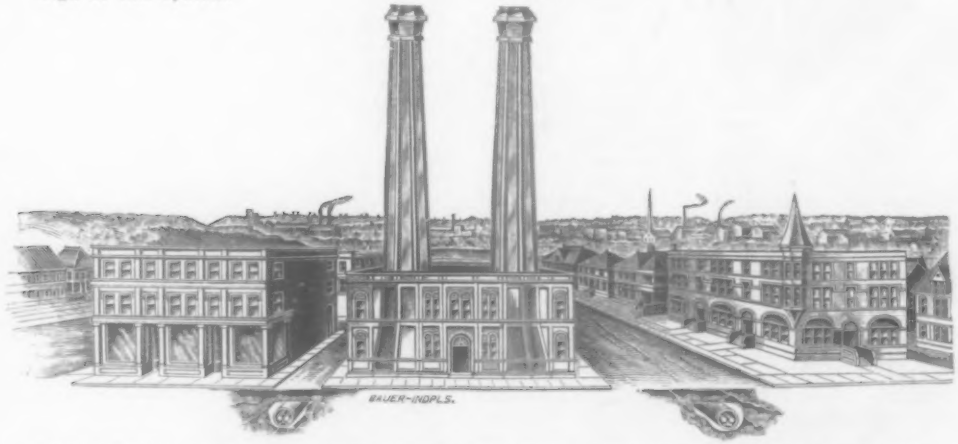
the largest boiler ever constructed. The advantages of central station heating are stated in a leading article in this number of Municipal Engineering, and a number of views of the Washington, O., plant are used as illustrations. The view on this page shows the standard design for a station for the distribution of heat and indicates the advantages of central location and concentration of fuel consumption in a large central plant which can easily be made smokeless.

The Washington, O., plant has a capacity for heating 300 houses and can be easily increased in size by adding boiler units of similar sizes.

There are some advantages in restricting the duty of a plant to heating only of which full advantage is taken in the design of this system.

tions for machinery, and other special purposes.

A very attractive Twentieth Century number of Power and Transmission has been issued showing among other items of interest some very excellent halftones of a quarter-Twist rope drive of the Dodge Manufacturing company of Mishawaka, Ind. Some arrangements for the comfort and advancement of employes of manufacturing establishments are also shown and their use described. Hints on the proper installation of machinery are numerous and valuable. The publication is very creditable and shows enterprise and progress. This number is volume 16, number 2. It is issued quarterly and is an attractive method of presenting information regarding the products of the firm and their application in manufacturing plants.



SMEAD STAND PIPE SYSTEM AND HOT WATER LINES. DESING FOR CENTRAL HEATING STATION.

Trade Publications.

The Pittsburg Filter Mfg., Co., Pittsburg, Pa., has issued an illustrated circular descriptive of the Ideal system of water purification, consisting of a plant for the purification of hot water for boilers, etc., acting continuously, and one for the purification of cold water, for laundries, hotels, etc., acting intermittently.

The Studebaker Bros. Mfg. Co., of South Bend, Ind., issue a Farmers' Almanac with the usual calendars and much information usually found only in more pretentious publications, in addition to advertisements of their goods.

Ten Years Practical Experience with Natural Rock Asphalt and its Products is the title of a booklet issued by the W. S. P. Shields Paving and Construction Co., 705-706 Witherspoon Building, Philadelphia, Pa., giving statements of the advantages of asphalt mastic for sidewalks, floors, roofs, and many other uses, and lists of users. Its use for street paving is emphasized, as well as on viaducts and bridges, and in founda-

Trade Notes.

ASPHALT.

The city of Detroit, Mich., has placed an order with Hetherington & Berner of Indianapolis, Ind., for a municipal asphalt plant, to be in working order by May 1.

The Interstate Paving company has been organized with a capital of $1,000,000 to lay and supply Obispo asphalt in the eastern states for street paving and other purposes. The principal office is located at present in Utica, N. Y. Charles S. Williams, Utica, is president and treasurer and W. M. Van Auken of Utica is vice-president and secretary. The company will compete with the asphalt trust. Mr. Williams was formerly president and Mr. Van Auken general counsel of the Utica paving company and the Alcatraz Construction company, which were absorbed by the trust. The company bid recently at Rome, N. Y.

BRICK.

The large plant of the Buckeye Pressed Brick company, at Roseville, O., has been transferred to the Ohio Pressed Brick company, a branch of the Hydraulic Brick company of St. Louis. The syndicate operates 29 plants.

William Wirt Clarke & Son, 115 Gay-st., south, Baltimore, Md., has been awarded the contract for suppiying vitrified street paving brick and terra cotta culvert pipe to the city engineer's department of Baltimore for the year 1901.

CEMENT.

The Reading Cement Co., near Evansville, Pa., is installing new engines, boilers, kilns and grinding machinery.

It is believed that a large cement plant will be erected near Orangeville, Barry county, Michigan, where extensive marl deposits have been located.

The Pyramid Cement company has been incorporated and a Portland cement plant will be established between Albion and Jackson, Mich. Detroit capitalists are interested.

Work on the proposed plant of the Standard Portland Cement company, recently organized, will begin as soon as spring opens. The plant will be located at Hamburg Junction, on Zukey Lake, Mich.

The plant of the Great Northern Portland Cement Company, at Baldwin, Mich., will probably be completed by June 1 The plant will ultimately have a capacity of 12,000 barrels a day and will occupy seventeen acres. The company owns 4,000 acres of marl land and 1,500 acres of clay.

The Chickamauga Cement Co., New Haven, Conn., has been incorporated by Samuel L. Bronson and Levi N. Blydenburg, of New Haven; Uriah Cummings and Homer S. Cummings, of Stamford. The company has completed a large plant at Rossville, Ga.

The syndicate of Detroit and Chicago capitalists that recently bought a large tract of land at Milltown, Ind., thirty miles west of New Albany, will establish a mill for the manufacture of Portland cement. The enterprise will represent an investment of $600,000 and the plant will have a capacity of 3,500 barrels.

The plant of the Southern Cement company, at North Birmingham, Ala., is completed and the manufacture of Portland and hydraulic cement has begun. The officers of the company are: President, Caldwell Bradshaw; vice-president and superintendent, Terrence C. Curtin; secretary and treasurer, T. M. Bradley.

William Wirt Clarke & Son, 115 Gay-st., South Baltimore, Md. have been awarded the contract for all the Portland cement that will be required at the Brooklyn Navy Yard for the year 1901. The company is now supplying Portland cement for the United States Government Printing Office in Washington, which will not be completed until some time next year.

The William G. Hartranft Cement company of Philadelphia is insuring that the names of the cements for which it is the sales agent shall be constantly before the eyes of engineers, users of and dealers in cement, by sending out line dates of convenient design on the heads of which are printed fac similes of the labels of the Phoenix and Old Dominion brands of Portland cement, the sale of which this company controls.

HOT WATER HEATING PLANTS.

The board of control, Cherokee, Ia., is considering the question of installing a hot water plant.

STREET LIGHTING.

The Cincinnati Gas Light company will absorb the Cincinnati Edison Electric company and all the other smaller electric lighting companies in Cincinnati.

Pittsburg capitalists are largely interested in the Ohio Valley Electric Light, Heat & Power company, which was organized in that city for the purpose of building and operating a municipal and commercial electric light plant in Steubenville, O.

A company has been organized at Niles, Mich., to manufacture electric lamps and transformers and other electrical specialties. The company will erect a two-story building. F. W. Stillwagon, W. H. Pritchard and P. J. Pritchard of Niles are interested.

J. Holt Gates & Co., Chicago, has just installed a 250 horse power Electric Power Plant for the Brower building, Chicago, in connection with Vilter Corliss engine. A great many of the electrical people of Chicago will occupy this building, and it will be a representative plant. This firm has been very busy this winter.

The Wiswell-Pritchard Electric Mfg. company, Niles, O., has been incorporated to manufacture electric lamps, transformers and other electrical supplies. The incorporators are: P. J. Pritchard, W. H. Pritchard and F. W. Stillwagon of Niles and Henry W. Wiswell and Chas. M. Wilkins of Warren.

The municipality of Newberry, Mich., has just started a 1,200 light Warren Inductor Alternator direct connected to an Erie Ball engine at a speed of 300 revolutions per minute for the unit. The council has been very much pleased with the outfit, which also operates two street lighting circuits of forty 50 candle power incandescent lamps each. The prominent feature of this plant is that there is not an oil cup on the outfit, and it is almost entirely automatic. The apparatus was furnished by J. Holt Gates & Co., Monadnock building, Chicago.

Newly incorporated companies: People's Electric Light & Power company, Kansas City, Mo.; Radiant Incandescent Light company, Rochester, N. Y.; West Nashville Power & Light company, Nashville, Tenn.; Georgetown Electric Light company, Ltd., Glen Williams, Ont., Canada; Glen Fay Power company, Ltd., Ottawa, Canada; Attica Water, Gas & Electric company, Attica, N. Y.; Bucyrus Gas & Electric Light company, Bucyrus, O.; Franklin Electric company, Davenport, Ia.; the Electric company, Warrenton, Mo.; Light, Heat, Transit & Public Service company., Fargo, N. D.

SEWER PIPE.

The Milwaukee Sewer Pipe & Supply Co., Milwaukee, Wis., was organized March 13

as the successor to the Master Plumbers' Sewer Pipe Association. Officers were elected as follows: President, H. C. Apel; vice-president, E. C. Kuetmeyer; treasurer, W. E. Goodman; secretary, I. H. Plumb. Directors—The officers and Charles Gezelschap, Henry Dearsley and F. R. Deugel.

The Ogden Sewer Pipe & Clay Co., Ogden, Utah, was incorporated March 12 to manufacture and sell drain tile, sewer and water pipe, brick and other clay products. The officers of the company are: President, James M. Harris; vice-president, Robert M. Gourlay; secretary, William E. Wester; treasurer, Robert B. Lewis.

At the annual meeting of the American Sewer Pipe Co., held in Jersey City, N. J., Alvah Trowbridge was elected director to succeed Charles Baird, resigned, with the other directors re-elected. The capital of the company is $9,000,000, of which $7,500,000 is stock and $1,500,000 is bonds. The company owns sewer pipe and fire brick plants in Pennsylvania, Ohio and Indiana, and controls about 90 per cent. of the output of sewer pipe in the United States.

WATER.

The Utility Water Supply company, Port Huron, Mich., has been incorporated to manufacture pumps and other articles for conveying water. The incorporators are Justus R. Whiting, E. F. Percival and George G. Moore.

MISCELLANEOUS.

The Marietta Stone company, Marietta, O., has been incorporated.

The Brownell Improvement company, Chicago, Ill., has leased the entire plant of the Momence Stone company, at Momence, Ill. G. E. Beale has been retained as superintendent.

The Dean & Hoffman company, Niagara Falls, N. Y., has been incorporated by Fred E. Dean, Albert J. Hoffman, Nellie E. Dean and Helen Hoffman. The company will engage in contracting, furnishing stone, etc.

The National Steel company has contracted with William B. Scaife & Sons, Pittsburg, Pa., for structural steel work for their Ohio works, consisting largely of floor beams, channels and columns.

The S. Howes company of Silver Creek, N. Y., invites bids for the supply of a steam power plant of 100 I. H. P., Corliss type engine and Cahall type upright water tube boiler preferred; induced or forced draft. Bids should be addressed to the company's engineer, M. L. Barbeau.

The Ft. Scott Flagstone and Paving company which operates the quarries on the W. I. Killion farm near Ft. Scott, Kas., will be reorganized at once. Elmer Coe, who is secretary and general manager of the company, has interested five capitalists of Kansas City in the company and officers will be elected as soon as the charter is received from the secretary of state. The quarries will be developed on a much larger scale and the business enlarged in all particulars.

The Union Paving company, Portland, Me., has been incorporated with a capital stock of $250,000. Birney A. Robinson and William W. Carter of Worcester, Mass., are president and treasurer respectively.

The Columbia Bridge company of Pittsburg, Pa., is erecting a new plant at East Carnegie. The present plant, which is located at Edenburg, near New Castle, is becoming inadequate for the increasing business.

The New York Bridge company has been incorporated to build bridges and other structures, by Hector M. Hitchings, Melvin J. Palliser and Irving V. Dooland. The principal office is at 152 Elm-st., Arlington, N. J.

The National Building Supply company, Baltimore, Md., will build a new two-story brick warehouse, 16 by 66 ft., on the site of 243 Smith's wharf.

The Durango & Zacatecas Construction company of Chicago, Ill., has been incorporated under Delaware laws to construct railroads, bridges and buildings.

The Electrical Inspection Maintenance company, Pierre, S. D., has been incorporated by J. H. Tomlinson, J. J. Post, Henry E. Leavitt, P. J. Knight, L. Taylor and L. C. Smith.

The New York Continental Jewell Filtration company, New York City, has been awarded the contract for installing a 32,000,000-gal. mechanical filtration plant at Little Falls, N. J., for the East Jersey Water company.

The entire power transmitting machinery, consisting of pulleys, couplings, hangers, collars and including a mile of shafting from three to nine inches in diameter for the distribution of 2,000 h. p. throughout the immense new plant of the Singer Manufacturing company, South Bend, Ind., now in course of erection, will be furnished by the Dodge Manufacturing company of Mishawaka, Ind.

In Machinery hall at the Pan-American exposition, Buffalo, one of the working exhibits will be operated by a Dodge American system rope transmission. Taking power from a 250 h. p. Murray engine, the rope will operate a 16x16 Roots rotary pump with capacity of 2,500 gals. per min., at a speed of 180 revolutions per minute. Intending visitors should make note and be sure to see this.

IMPROVEMENT AND CONTRACTING NEWS.

PAVING.

St. Paul, Minn.—The Board of Public Works has adopted a change in the specifications for asphalt paving which will permit competing companies to bid.

Los Angeles, Cal.—The Board of Public Works has recommended the adoption of new asphalt specifications which will open competition to all asphalt companies and contractors.

Albany, N. Y.—State Engineer Bond says that up to Feb. 12, 1901, 35.17 miles of state roads have been completed at a cost of $266,213. There are 18.41 miles under contract at an estimated cost of $162,953, and the various counties have appropriated $470,306 for their share of building 150.14 miles more.

Butte, Mont.—A new law passed by the recent legislature for public improvements, known as the Gensen law, instead of requiring the signature of two-thirds of the

property-owners in order to make a public improvement requires that the protest must be signed by two-thirds of the property-owners in order to be effective.

CONTEMPLATED WORK.

Lorain, O.—Second-ave. will be paved.

Pontiac, Ill.—Paving is contemplated for a number of streets.

Kenton, O.—About 8,000 sq. yds. of street paving is contemplated.

Waco, Tex.—About $30,000 of paving is contemplated. J. W. Riggins, mayor.

Oskaloosa, Ia.—Paving is contemplated for S. Third-st. Mayor Wray.

Columbus Grove, O.—About 3,000 sq. yds. of paving is proposed this summer.

Manhattan, Kas.—Brick paving is proposed for Houston-st., west from Third-st.

Baltimore, Md.— The county commissioners have decided to macadamize Sutton-ave.

Dunkirk, N. Y.—Petitions are being circulated to pave Elk and Deer-sts.

Columbus, Ga.—The property-owners on Hamilton-ave. have petitioned for paving.

Tilton, N. H.—The citizens voted in favor of macadamizing Main-st. to the Franklin line.

Evanston, Ill.—An ordinance has been passed providing for paving Harrison-st.

Bristol, Tenn.—About 3,500 sq. yds. of brick paving is proposed. W. L. Reynolds, engr.

Detroit, Mich.—The business men on Gratiot-ave. are in favor of resurfacing the avenue.

Washington, Ia.—The business men are considering the question of paving the public square.

Shreveport, La.—This city has voted to issue $80,000 bonds for paving and street improvements.

Seattle, Wash.—A petition is being circulated to pave ten and one-half blocks of Highland drive with asphalt.

Canton, O.—Bids will be asked early in April for paving a number of streets. P. H. Weber, cy. engr.

York, Pa.—Ordinances have been passed for macadamizing Park and King-sts. and Boundary and Linden-aves.

Port Lavaca, Tex.—The question of issuing $15,000 bonds for roads and bridges will be voted April 30.

Davenport, Ia.—A resolution has been passed to pave Rockingham road and Third, Fourteenth and Fifteenth-sts.

Paterson, N. J.—About 33,751 sq. yds. of asphalt and 330 sq. yds. of brick paving is contemplated this year.

Anderson, Ind.—Bids will probably be received about April 15 for paving 1½ mls. of streets with brick.

Camden, N. J.—This city has ordered the Camden & Suburban railway company to pave about 25,000 sq. yds. of Third-st. with asphalt.

Lead, S. D.—The question of street paving is urged and it is probable that experiments will be made with slag paving.

Champaign, Ill.—The property-owners on N. Clark-st., from Neil to New, are agitating the question of paving.

Earlham, Ia.—A petition for macadamizing Chestnut-st., from Main to Ohio-aves., has been submitted to council.

Decatur, Ill.—Favorable action has been taken by the city council committee for paving Cerro Gordo-st. with asphalt.

Everett, Wash.—The city council has ordered 2½ mls. of street paving, and has asked for specifications for 5 mls. of grading.

Oshkosh, Wis.—The question of paving Algoma-st. with asphalt is being considered, according to local press reports of March 22.

Los Angeles, Cal.—A resolution was adopted March 11 for repairing Main-st., from First to Marchessault, with asphalt.

Dunmore, Pa.—Victor Burschel, burgess, recommends macadam paving for Blakely-st., from Drinker-st. to the Scranton city line.

Portland, O.—Brick paving is proposed for Fourth-st. to replace the wooden block pavement, according to local press reports.

Waterbury, Conn.—The property-owners on Phoenix-ave., from E. Main-st. to Abbott-ave., are unanimously in favor of brick paving.

Cleveland, O.—The property-owners in Euclid Heights have donated land for a boulevard to be built from the Heights to Euclid-ave.

Camden, N. J.—An ordinance has been passed to pave Western-st., between Broadway and Ferry-ave., with Belgian block. H. C. Kramer, clk. cy.

Cedar Rapids, Ia.—The need of paving several cross streets with asphalt is pointed out in the annual report of Geo. H. Meredith, cy. eng.

Bowling Green, O.—Plans are being prepared for 66,033 sq. yds. of brick and asphalt paving, according to press reports. Alex. Williamson, clk.

Pittsfield, Mass.—A committee has been appointed to investigate the question of macadamizing North and Wests-sts. H. A. Fobes, engr. B. P. W.

Philadelphia, Pa.—The council's highway committee has apportioned the $750,000 appropriated for repairing rubble or cobblestone paved streets with asphalt.

Troy, N. Y.—Asphalt block paving is proposed for a portion of Jacob-st. Brick paving is favored for Pawling and Oakland-aves. Cy. Engr. Cary.

Topeka, Kas.—The adoption of resolutions was recommended March 16 for brick paving in portions of Seventh, Ninth, Tyler, Buchanan and other streets.

Cincinnati, O.—A petition for paving parts of Taylor and Columbia-aves. and Hoge-st., with asphalt block, was referred to the city engineer March 14.

Sioux City, Ia.—Preliminary action has been taken for brick paving in portions of Jackson, Jones, Jennings, Court, Virginia, Iowa and Third-sts. this summer.

Denver, Col.—Joel W. Schackelford, president of the board of public works, favors disintegrated granite macadam for the residence streets of this city.

Spartanburg, S. C.—(Special)—T. H. Knox, engr., says that bids will be received about May 1 for 15,000 sq. yds. of brick paving and 12,000 sq. yds. of block paving.

Akron, O.—A petition has been approved by the city commissioners for improving Wheeler Lane alley. Taylor-st., from Main-st. to the canal, has been ordered paved.

Utica, N. Y.—The petitions for paving Avery, State and Roberts-sts. have been favorably reported and council will determine, April 5, the kind of material to be laid.

Swissvale, Pa.—The borough council passed seventeen improvement ordinances March 19 providing grading and paving for a large number of streets. A hearing will be given April 4.

La Crosse, Wis.—(Special.)—Wendell A. Anderson, mayor, says that 7,300 sq. yds. of brick paving on 6 in. concrete and 40,000 sq. yds .of macadam paving is contemplated.

Petaluma, Cal.—(Special.)—N. S. Frost, cy. engr., says that resolutions of intention to grade, curb and macadamize portions of Walnut, Union, A and Second-sts. have been passed.

Fort Wayne, Ind.—(Special.)—F. M. Randall, cy. engr., says 18,560 sq. yds. of asphalt paving on concrete foundation and 17,900 sq. yds. of brick paving on concrete foundation are contemplated.

Mason City, Ia.—Petitions are being circulated for paving Washington-ave. The residents on the street are in favor of asphalt paving, but it is probable that sandstone macadam will be selected.

Michigan City, Ind.—(Special.)—H. M. Miles, cy. engr., says that bids will be received the latter part of April for 22,500 yds. of brick paving on concrete and 27,500 sq. yds. on crushed stone.

La Crosse, Wis.—The city engineer has been instructed to prepare plans and ask for bids for brick paving on Third, Pine and Badger-sts. and macadam paving on West-ave., Market and Slate-sts. Cy. Engr. Powell.

Norwich, N. Y.—Plans, specifications and estimates for paving a portion of Broad-st. with brick and a portion of Broad, N. Broad and Silver-sts. with macadam have been submitted to the village trustees.

Council Bluffs, Ia.—(Special.)—S. L. Etnyre, cy. engr., says the ordinance for 71,000 sq. yds. of two-course brick paving will come up for final hearing April 8, after which bids will be received.

Fairfield, Ia.—A resolution is pending in the council providing for two-course brick paving with curbing on Burlington, Maine, Broadway and Court-sts.. Jos. Ricksher, mayor; J. F. Deradurff, cy. clk.

Cohoes, N. Y.—A hearing will be given April 4 in the proposed paving of Ontario, Broadway, Lancaster, St. John, Newark, Schuyler, Grant, Newcomb, George, Seneca and Main-sts. and Johnston and Youngloveaves.

Ogden, Utah.—The question of paving Washington-ave., between Twenty-third and Twenty-sixth-sts., is being considered. The property-owners are reported as being in favor of macadam. M. S. Browning, mayor.

Toronto, Canada—The city engineer has recommended the following: Asphalt paving—Wellington, King, Queen and Balmuto-sts., Burk, Bathurst, Manning and Georgeaves. Cement Walks—Terauley, Beverly, Herne and Yorke-sts.

St. Joseph, Mo.—The property-owners on N. Third-st., between Franklin and Albemarle, have decided that the street must be paved, but they are divided on the material to be used. Asphalt, brick, macadam and granite blocks are advocated.

Owosso, Mich.—The board of public works is reported as being evenly divided on the question of paving with asphalt or brick this summer. The question of issuing $37,000 bonds for paving W. Main-st. will be voted on this spring.

Grand Rapids, Mich.—Estimates have been submitted for macadamizing Godfrey-ave. as follows: Macadamizing with vertical stone curb and brick paved gutters, $15,903.50; brick with gravel foundation, $13,903.50; brick and concrete foundation, $24,142.40.

Columbia City, Ind.—(Special)—A. N. Miller cy. engr. says that resolutions have been passed and the contract will be let about May 1 for 2½ or 3 miles of brick or macadam paving on stone foundation with sand cushion on three of the principal streets.

Baltimore, Md.—Ordinances were passed March 18 for paving Chesapeake-st., between Fairmount-ave. and Fayette-st. An ordinance was introduced for repairing Fort-ave., from the B. & O. R. R. tracks on Lawrence-st. to Ft. McHenry, with Belgian blocks.

Minneapolis, Minn.—The principal paving to be done during the present year will be on Washington-ave., north, between Thirty-second and Forty-second-aves., which will be paved with macadam with gravel top dressing. Considerable work will also be done on the east side, University-ave. and Seventh-st., southeast.

Richmond, Va.—Col. John Murphy is urging this city to pave Eighth-st., between his present hotel and the annex which is to be built on the western side of Eighth-st., with asphalt on vitrified brick. As he is willing to bear a portion of the expense it is possible that the street committee will consider his proposition.

Wapakoneta, O.—(Special)—Samuel Craig, surveyor, says the council passed a resolution March 26, declaring it necessary to improve Blackhoof-st., from Auglaize-st. to the T. & O. C. R. R., a distance of 2,100-ft., by grading, draining, curbing and paving with brick. The engineer was ordered to prepare plans and specifications.

Newark, N. J.—City Counsel Price has rendered an opinion to the board of works stating that the board can advertise for bids for more than one kind of paving. Motions of intention were published March 7 for paving ten streets with asphalt and seven streets with granite.

Boston, Mass.—The street department has decided to pave the following streets this year: Asphalt—Gold-st., $4,770; Bowen-st., $7,700; Tudor-st., $3,700; Silver-st., $7,700; Athens-st., $3,900; streets bounding Copley-square, $42,100; Massachusetts-ave., N. S. Beacon-st., across Huntington-ave., $74,000; Boylston-st., $34,000; Arlington-st., $31,000; Beacon-st., $42,000. Granite Blocks—Congress-st., $42,000; High-st., $44,700; Union-st., $181,400; Dock, Faneuil Hall and Adams-squares, $251,000; Franklin-st., $18,700; Milk-st., $16,400; Indian-st., $10,100; Pearl-st., $16,700; E. First-st., $23,300.

Indianapolis, Ind.—Resolutions were adopted March 27 for the paving as follows: Asphalt: State-ave., Washington to Michigan; Sutherland-ave., Central to College-ave.; Bellefontaine-st., Fifteenth to Twenty-first-st. Gravel, with Cement Walks and Curbing—Warman-ave., from Tenth to Clark. Wood

Blocks—Highland-ave., from Washington-st. to Marlowe-ave.; Ohio-st., from Noble-st. to Arsenal-ave., and Illinois-st., from Fall creek to Thirty-fourth-st. The list of improvements for which plans have been prepared includes about eighty streets, consisting of asphalt, brick, gravel and wooden block paving and cement walks.

Ashland, Wis.—(Special.)—Finley Wharton, cy. clerk, says that recommendations were submitted by the board of public works March 12 to the common council for the following: Slagging Second-st., W. from the Omaha railroad track to Fiftenth-ave., W., three blocks, in place of the present cedar block pavement; curbing and slagging Second-ave. to Fourth-ave. W., and Vaughn-ave., two blocks each, from Front to Third-sts. No action was taken on the recommendation. The board also called the attention of the council to the fact that Second-st., from Stuntz-ave. to Fifteenth-ave. W., 22 blocks, will require repaving within a year, and recommends brick as the most sanitary and economical paving material.

CONTRACTS TO BE LET.

Waukesha, Wis.—Bids are asked until April 13 for paving certain streets, according to press reports.

Omaha, Neb.—Bids are asked until April 5 for grading Twenty-second-st., from Fowler to Meredith-ave. B. P. W.

Cincinnati, O.—Sealed bids are asked until April 6 for improving the Montauk road. E. L. Lewis, co. engr.

Wilkesbarre, Pa.—Bids are asked until April 9 for brick paving on St. Clements-st. D. J. Jones, chmn. Joint St. com.

Waukesha, Wis.—Sealed bids are asked until April 13 for macadamizing Maple and Dunbar-aves. J. P. Day, cy. engr.

Astoria, Ore.—Bids are asked until April 3 for constructing 42 miles of road or any part of it in Clatsop county. H. J. Wherity, co. clk.

Columbus, Ind.—Sealed bids are asked until April 8 for constructing a macadam road from Greenland to Haddenfield. Dr. J. B. Davis, dir.; J. J. Albertson, co. eng.

Van Wert, O.—Sealed bids are asked until April 16 for furnishing, crushing and delivering 54,000 yds. of crushed stone or gravel in Pleasant road district. G. L. McKibben, cons. engr.

Spokane, Wash.—Sealed bids are asked until April 9 for paving Washington-st. with asphalt on cement concrete foundation, with granite curbing. R. E. Clarke, secy. B. P. W.

Cincinnati, O—Sealed bids are asked until April 15 for the construction and repair of all brick sidewalks in the eastern and western sidewalk districts. Robert Allison, Prest. B. P. S.

Chicago, Ill.—Sealed bids are asked until April 10 for the stone and earth now piled along the channel of the main drainage canal between Roby-st. and Lockport. Alex. J. Jones, Pres. bd. trustees.

Winnipeg, Maine—Sealed bids will be received until April 18 for the supply and delivery of 200 tons of asphalt for street paving. Check or cash deposit of $400 required. C. J. Brown, Cy. Clk.

Findlay, O.—Sealed bids are asked until April 20 for paving Cory-st., from Fair to Frazer, with vitrified block, with curbing, gutters, crosswalks, drainage, etc. Frank C. Ray, clk. bd. impvts.

Bellefontaine, O.—Sealed bids are asked until April 3 for macadamizing, curbing and guttering six streets, consisting of about 98,832 sq. yds. of macadam and 24,000 ft. of curbing and guttering. M. J. Nichols, Cy. Clk.

CONTRACTS AWARDED.

Greenville, O.—Webster & Farr secured the contract March 18 for paving Washington-ave. with brick.

Harrison, N. J.—The Barber Asphalt Paving company was awarded the contract March 5 for paving Lodi-st, with asphalt for $2,578.50.

Chillicothe, O.—Plaff, Ringwald & Smith submitted the lowest bid March 8 for brick paving and curbing at $21,428.56.

Bloomington, Ill.—John Cherry was awarded contracts March 14 as follows: Park-st., $12,851.28; Evans-st., $1,029.16; Beecher-st., $2,195.27.

St. Paul, Minn.—Fielding & Shepley secured the contract for boulevarding and curbing Laurel-ave., from Victoria to Chatsworth-st., for $2,110.

Des Moines, Ia.—The Likes Improvement company has been awarded a contract for 3,362 sq. yds. of brick paving at $1.62 a sq. yd. on 6-in. broken stone concrete foundation.

Kansas City, Mo.—Paving contracts have been awarded to Fred Fingel, the Gilsonite Paving company, the Trestrail Paving company, A. R. Mense and the Barber Asphalt Paving company.

Elizabeth, N. J.—Paving contracts have been awarded as follows: N. Broad-st., asphalt, Barber Asphalt Paving company, $59,022; Spring-st., Telford, Michael Fitzgerald, $5,342.

Council Bluffs, Ia.—(Special.)—S. L. Entyre, cy. engr., says contracts for 76,000 sq. yds. of brick paving was awarded to E. A. Nickham and 17,000 sq. yds. to B. P. Nickham.

Easton, Pa.—The Delaware River Quarry and Construction company has been awarded the contract for improving the Delaware river road from the eastern to the Bucks county line for $37,616.

Davenport, Ia.—The Davenport Construction company submitted the lowest bid March 19 for brick paving as follows: Fifteenth and Sixteenth-sts., $1.28 a sq. yd.; Third-st., $1.27; Rock road, $1.26.

Freeport, Ill.—The contract for paving the roadway along the Central & Northwestern freight house, from Stephenson to Washington-st., with vitrified brick in cement was awarded to G. J. W. Stewart for $7,000.

Seattle, Wash.—The San Francisco Paving company was awarded the contract March 12 for $46,000 worth of macadam paving in the first forty acres of the tract of land owned by the Moore Investment company.

Ripon, Wis.—The contract for brick paving was awarded to T. J. McGrath of Green Bay, Wis., as follows: Metropolitan block, $1.59 a sq. yd.; excavating, 23 cents a cu. yd.; stone curbing, 37 cents a foot.

Elgin, Ill.—The contract for paving Forest-ave. with brick was awarded to Smith, Moss & Brown of Chicago for $5,074. The same company secured the contract March

18 for paving Brook-st. with brick for $8,350.

Lawrence, Kas.—The contract for paving Tennessee and Warren-sts. with brick was awarded March 4 to Chapin & Greener at $1.37½ a sq. yd. Ritchie & Ramsey secured the contract for paving Henry-st. with brick, March 18, at $1.34½ a sq. yd.

St. Paul, Minn.—The Barber Asphalt Paving company submitted a bid March 5 for repairing asphalt pavements on which contract the guarantee term has expired, as follows: Sheet asphalt, without cement, $2 a sq. yd.; concrete foundation, $1 a sq. yd.

Racine, Wis.—Macadam paving contracts were awarded March 16 as follows: Milwaukee-ave., P. B. Johnson, with sandstone curbing and brick gutters; W. Main-st. and High-st., R. R. Birdsall; Mead-st., James Cape & Son; Washington-ave., Nelson & Harding.

Petaluma, Cal.—(Special.)—W. S. Frost, cy. engr., says bids have been received for 1,440 sq. ft. of cement walks at 10 cents; 4,000 sq. ft. at 11¾ cents; 3,700 cu. yds. of grading at 21 cents, and 7,830 sq. ft. of grading and macadamizing at $3.44 complete.

Annapolis, Md.—Joseph Jewell was awarded the contract March 18 for paving King, George, Holland, Craig, East, Randall and South-sts. with rubble stone for $5,754.77; to George Jewell for paving Northwest, Carroll, North and Franklin-sts. with rubble stone, for $9,326.77.

Joliet, Ill.—The contract for paving Cass-st., bids for which were opened Feb. 25, was awarded to C. J. Smith of this city as follows: Three thousand six hundred square yards of Galesburg brick paving, $1.37; 1,400 lin. ft. curbing, 47 cents; 60 cu. yds. extra concrete, $2.25; total, $5,725.

Toledo, O.—The lowest bidders for paving Tenth-st., from Washington to Adams, March 21, were as follows: C. M. McKinney, vitrified block with Indiana curbing, $16,932.20; Barber Asphalt Paving company, Trinidad pitch lake, $12,123.40; Cleveland Trinidad Paving company, Trinidad asphalt, $13,719.69; C. H. Burchenal, asphalt block, $13,812.05.

Baltimore, Md.—The contract for paving Baltimore-st., from Grave-st. to the eastern limits, with asphalt, was awarded March 14 to the Southern Asphalt Paving company at $2.17 a sq. yd., or $19,264.67. The Filbert Paving and Construction company was awarded the contract for paving Maryland-ave. with Belgian block at $1.99 a sq. yd. or $211,693.61.

Chicago, Ill.—Bids were received March 20 for $570,000 worth of street paving. The R. F. Conway company was lowest bidder on the following: Forquer-st., brick, $2.13 a sq. yd.; Grand-ave., brick, $2.14; Haymarket-st., granite block, $3.59; Fortieth-ave. system, macadam, 88 cents for paving and 62 cents for curbing. The other low bids submitted were W. Adams-st., asphalt, Standard Paving company, $2.24; Albany-ave., asphalt, Western Paving and Supply company, $2.10; Forty-seventh-st., macadam, T. Burke, $1.52; Normal-ave., macadam, Smith, Moss & Brown, 70 cents.

St. Paul, Minn.—(Special)—Bids were opened March 21 for asphalt paving as follows: Rice-st., from College-ave. to University-ave., R. F. Conway Co., Chicago, city's portion, 10,516 sq. yds., $22,285; railroad's portion, 2,567 sq. yds., $5,647; total $27,932; Barber Asphalt Paving company, $27,087.33 and $6,494.51 respectively; total $33,581.84. Rice-st., from University-ave. to Como-ave., R. F. Conway Co., city's portion, 2,958 sq. yds., $6,589; railroad's portion, 2,537 sq. yds., $5,581; total $12,270; Barber Asphalt Paving company, $7,695.60 and $6,418.61 respectively; total $14,114.21.

Atlanta, Ga.—Bids were received March 18 for paving Capitol-ave. with asphalt as follows: Warren Brgs., Utica, N. Y., California asphalt, 2 inches; surface, 1-inch binder, using stone for concrete, $2.63 a sq. yd.; using old stone for concrete, $2.53; Southern Paving and Construction company, Chattanooga, Tenn., using stone for concrete, $2.53; using old macadam for concrete, $2.34; 1½ inches asphalt and 1½ inches cushion, $2.75 a sq. yd.; 2 inches asphalt and 1½ inches cushion, $2.75; Venable Bros., Atlanta, using new stone, $2,529; using old macadam, 1½-inch Trinidad and 1½-inch cushion, $2.49.

Buffalo, N. Y.—Bids were received March 6 for paving or repaving eleven streets. The Warner-Quinlan Asphalt company bid on nine of these streets and was the lowest bidder on five of them. Bids were opened March 14 for paving Grace and Tousey-sts., and Pomona-place. The Warner-Quinlan company was the lowest bidder on Grace-st., the German Rock Paving company on Tousey-st., and the American Contracting company on Pomona-place. The Warner-Quinlan company submitted the lowest bid March 20 and secured contracts for the following streets: Prenatt-st., $2.249 a sq. yd.; Burgard-place. $2.695; repairing Ohio-st., $1,484.

Rome, N. Y.—Bids were opened March 12 for paving three streets, as follows: N. George-st., Barber Asphalt Paving company, asphalt, $31,676; Warren-Scharf Asphalt Paving company, Utica, N. Y., asphalt, $32,771; Warner-Quinlan Asphalt Paving company, Syracuse, N. Y., asphalt, $32,000; Interstate Paving company, Rome, N. Y., asphalt, $35,972; N. J. Cramond, Rome, brick, $40,488 to $44,438; Louis W. Edy, Rome, brick, $41,390 to $44,850. W. Dominick-st., N. J. Cramond, brick, $9,153 to $10,126. N. Washington-st., Barber Asphalt Paving company, asphalt, $24,587; Warren-Scharf Paving company, $25,179; Interstate Paving company, $28,127; Warner-Quinlan Asphalt company, $24,014; N. J. Cramond, brick, $30,541 to $33,781.

Minneapolis, Minn.—Bids were opened March 8 for furnishing materials as follows: For granite paving blocks, 40,000 sq. yds.: Robert Graham bid $1.70 per sq. yd. rock faced or ⅝-in. top and $2.03 per sq. yd. ½-in. face. Arnold Granite company bid $1.44½ and $1.69½ per sq. yd. For asphalt paving blocks, 40,000 sq. yds.: Lake Erie Asphalt Block company bid $1.92 per sq. yd. for blocks 3 in. thick, 12 in. long and 4 to 5½ in. wide; $2.11 for blocks 4 in. thick, 12 in. long and 4 to 5½ in. wide. For asphalt furnished and delivered, 40,000 sq. yds.: Barber Asphalt Paving company bid $1.98 per sq. yd., or furnished and laid, $2.05 per sq. yd. For vitrified brick, 40,000 sq. yds.: Flint Brick company bid 98 cts. per sq. yd.; specials, 25 cts. per sq. yd. additional. Purington Paving Brick company., 98 cts. per sq. yd.; specials, 25 cts. per sq. yd. additional. Gales-

burg Paving Brick company, 91 cts. per sq. yd.; specials, $1.20 per sq. yd. Wooster Shale Brick & Clay company, $1.13 per sq. yd.; specials, $1.17 per sq. yd.

Garrett, Ind.—(Special.)—J. J. Van Auken, C. E., says that the contract for brick street paving in this city was awarded March 5 to Kelley Bros. of Portsmouth, O., as follows: 11,000 cu. yds. exc. 22 cts. per cu. yd. in cut; Metropolitan block paving, including gravel stone foundation and cement filler, $1.16 a sq. yd; curb, 4x18 laid, 33 cts. a lin. ft. Bedford stone curb, 4x20, 35 cts.; 5x22, 45 cts.; 6x24, 54 cts.; headers, 3x15, 16 cts.; street inlets, $10 each; manholes, $30 each; cement walk and curb, 13 cts. a sq. ft.; cast iron pipe, 3 cts. per lb.; cast iron crossings, 3 cts. per lb.; 8 in. sewer pipe, 90 cts.; 8 in. sewer traps, $4 each; 4 in. drain tile, 5 cts. per ft.; sand filler, 5 cts. a sq. yd.; total, $42,438.25. The other bidders were Petit & Abele of Zanesville, O.; Hill, Kellner & Groscop, Garrett, Ind.; Kerlin Bros. & Co. of Toledo, O.; E. M. Seamans, Grand Rapids, Mich.; Wayne Paving company, Detroit, Mich.; F. M. Kemp & Sons, Middletown, O.; Thomas Burke, Chicago, Ill.; C. M. Kirkpatrick, Greenfield, Ind.; Frank Brumbaugh, Elkhart, Ind.; Robert Hoban & Roach, South Bend, Ind.; E. E. Moellering & Co., Ft. Wayne, Ind.; Derheimer & Hill, Ft. Wayne, Ind.; W. W. Hatch & Son, Goshen, Ind.; Moore & Henley, Bloomington, Ind.; F. B. & J. J. VanAuken, engrs., Auburn.

SEWERS.

Baltimore, Md.—Walter Stebbins has been appointed to serve on the sewerage commission to take the place of Mendes Cohen, who declined to serve.

Galveston, Tex.—Judge Stewart rendered a decision March 7 in the mandamus case of the Galveston Sewer company vs. Mayor Walter O. Jones. The decision was in favor of the plaintiff. The action was brought by the sewer company to compel Mayor Jones to sign a warrant for $93,600, which amount was appropriated by the city council for the purchase of the plant of the Galveston Sewer company.

CONTEMPLATED WORK.

Green Bay, Wis.—A large number of sewers will be built.

Watertown, Mass.—This town has appropriated money for sewer construction.

Massillon, O.—The construction of three sewers is recommended.

Belmond, Ia.—A petition is being circulated for a sewer on Main-st.

Gardner, Mass.—The sum of $21,000 has been appropriated for sewers.

Atlanta, Ga.—The extension of the Wall-st. trunk sewer is contemplated.

Janesville, Wis.—The question of building a sewerage system will be voted on.

Menasha, Wis.—The expenditure of $14,000 for sewer construction is proposed.

East Hampton, Mass.—The sum of $6,000 has been appropriated for new sewers.

East Syracuse, N. Y.—The question of a sewerage system is still under discussion.

East Cleveland, O.—The council has decided to double the present sewage disposal plant.

Bennington, Vt.—This village voted March 19 to survey for a surface system of sewers.

Abilene, Kas.—The residents west of the creek are agitating the question of building a sewer.

Sherman, Tex.—The question of issuing $80,000 bonds for building a sewerage system will be voted on April 2.

Sandy Hill, N. Y.—This town has voted to issue $95,000 bonds for building a sewerage system. J. P. Monty, engr.

Sault Ste. Marie, Mich.—Plans for a complete sewerage system are being made by Louis Chipman, C. E., of Toronto, Ontario.

Florence, Tenn.—The council has decided to issue $5,000 bonds for building a new stone sewer in the western part of town.

Indianapolis, Ind.—Petitions were filed, March 27, for a main sewer in Northwestern-ave. and local sewers in certain streets.

La Crosse, Wis.—(Special.)—Wendell A. Anderson, mayor, says an extension of 2,000 ft. of 12-in. sewer is contemplated.

Madison, N. J.—L. L. Tribus, C. E., New York City, has been engaged to advise the borough regarding a sewerage system and disposal plant.

Springfield, Mo.—An ordinance has been passed establishing sewer district No. 16 of Section 2 of the main sewers. Ralph Walker, mayor.

Chicago, Ill.—Definite plans were decided upon by L. E. McGann, com'r of pub. wks., March 14, for the construction of sections G and H of the intercepting sewers.

St. Paul, Minn.—(Special.)—O. Claussen, cy. engr., stated, March 12, that bids for a sewerage system costing approximately $40,000 would be advertised within a week.

Dayton, O.—A resolution was adopted, March 8, instructing City Engineer Turner to prepare plans and specifications for sewers in Salem, North, Neal and Bellevue-aves. and Summers-st.

Ashland, Wis.—(Special.)—Finley Wharton, cy. clk., says that the construction of a sanitary sewer in the alley between Eleventh and Twelfth-aves., from Fourth to Eighth-sts., has been recommended.

Newark, N. J.—Representatives of Newark, Vailsburgh, Irvington, South Orange, West Orange, Millbury and Summit met March 15 and signed a contract to carry out the joint trunk sewer project.

Celina, O.—(Special.)—The city council has passed a resolution for an election to be held April 1 for the purpose of issuing $50,000 bonds for the purpose of building a sewerage system. Mayor Landfair.

Baltimore, Md.—Mayor Hayes, City Engineer Fendall, City Water Engineer Ivick, Electrical Engineer Phelps and Kenneth Allen, consulting engineer, decided, March 4, that a $12,000,000 sewerage loan was necessary.

Michigan City, Ind.—(Special.)—H. M. Niles, cy. engr., says that bids will be received in April for 1,000 ft. of 30 and 24-in. brick sewer; 1,500 ft. of 18 and 15-in. pipe, 2,000 ft. of 12-in. pipe and 1,940 ft. of 10-in. pipe sewers.

Winchester, Ind.—(Special.)—C. C. Yunker, cy. engr., says that he is making plans and specifications for a separate sewerage system consisting of about 3 mls. of trunk or

main sewers and ten miles of lateral sewers.

The construction of sewerage systems is contemplated at the following places: Savannah, Ill.; New Decatur, Ala.; Burlington, N. J.; Oswego Falls, N. Y.; Hartford City, Ind.; Venice, Ill.; Oneonta, N. Y.; Merced, Cal.; Clarksburg, W. Va.; Connellsville, Pa.

CONTRACTS TO BE LET.

Ocean City, Md.—Bids are being asked until April 3 for a sewerage system. John L. Streeter, cy. clk.

Decatur, Ind.—Bids are asked until April 2, for building a sewer in Elm-st. H. B. Knok, c. y. engr.

Circleville, O.—Sealed bids are asked until April 8, for building sewers. Fred R. Nicholas, cy. clk.

Cincinnati, O.—Sealed bids are asked until April 3, for building a sewer in Bloody Run. Robert Allison, pres't B. P. S.

Omaha, Neb.—Sealed bids are asked until April 5 for sewers in Burdette, Ohio, Castelar and Twenty-seventh-sts. B. P. W.

Newark, N. J.—Bids are asked until April 4, for 4,765 ft. of 105 to 58 in. brick trunk sewer. Bd. lt. and water comm's.

Merchantsville, N. J.—Proposals are desired for building a complete sewerage plant on the franchise plan. William A. Holham, chm. borough. W. B. Stewart, clk.

Havana, Cuba.—Sealed bids are asked until May 29, (postponed from April 3rd) for a sewerage system. W. J. Borden, Corps of engrs. U. S. A. Ch. engr. city of Havana. Alexandre Rodrigues, mayor.

CONTRACTS AWARDED.

Olathe, Kas.—The contract for constructing a main sewer has been awarded to M. L. Kinlen of Kansas City, Mo.

Des Moines, Ia.—The Likes Improvement company secured the contract for an overflow sewer at First and Ivant-sts., for $1,195.

Xenia, O.—The contract for building a large sewerage system was awarded to A. F. Shover, Indianapolis, for $20,155.40.

Webb City, Mo.—The contract for building new sewers was awarded March 12 to the Meyer Construction company of St. Louis, for $9,259.31.

Bloomington, Ill.—J. H. Colby of St. Louis was awarded the contract Nov. 15 for extending the west slough sewer 1616-ft., for $9,000.

Kansas City, Mo.—Mr. Michael Walsh secured the contract for a sewer from Eighteenth and Tracey-sts. to Twenty-seventh and Brooklyn-sts., for $71,045.

Denver, Colo.—The contract for work in sub-district 19 of the Capitol Hill storm sewer dist. No. 1 was awarded to the John M. O'Rourke Construction company, for $11,376.

Bridgeport, Conn.—The contract for 1,250-ft. of new sewer, including manholes, basins, slants, etc., has been awarded to the Pierce Manufacturing company of this city, for $7,684.50.

Joplin, Mo.—(Special)—S. J. McKee, cy. engr., says the contract for building 400-ft. of 8-in. pipe sewer was awarded to the Jopline Construction company, March 5, at $1.70 a lin. ft.

Glencoe, Ill.—The contract for building 18,097-ft. of sewers was awarded March 16 to Charles M. Porter of Chicago for $19,756. The contract for the purification plant has not yet been awarded.

Neenah, Wis.—(Special)—L. C. Hjorth, cy. engr., says the contract for constructing sewers in the First and Second districts was awarded March 22 to J. H. Green & Son, of Appleton, Wis., for $14,013.05. The work consists of the following: 1,100-ft., 30-inch; 1,082-ft., 24-inch; 844-ft., 20-inch; 708-ft., 18-inch; 6,749-ft., 15-inch; 1,511-ft., 12-inch; 1,450-ft., 9-inch; all to be of standard vitrified pipe. Also 28 manholes, 42 catchbasins and 8 lampholes, all complete with iron tops; all materials to be furnished by contractor.

WATER-WORKS.

Murfreesboro, Tenn.—This city has in contemplation the purchase of water works.

San Diego, Cal—This city purchased the entire property of the San Diego Water company, March 13, for $500,000.

Independence, Ia.—The city council will investigate the water supply, which, it is claimed, is responsible for the typhoid at the State insane hospital.

Chicago, Ill.—The American Water company has begun suit in the circuit court against the Chicago Union Traction company, alleging injury to the company's water pipes through electrolysis.

Boston, Mass.—The Metropolitan Water and Sewerage Boards have been consolidated and Henry H. Sprague, Henry P. Walcott and Jas. A. Bailey, jr., appointed commissioners of the new board.

Butte, Mont.—Judge Knowles of the United States court authorized March 4 the sale of the property of the Butte City Water company to satisfy a claim of $2,412,814.57 held by the Massachusetts Loan and Trust company.

Mt. Vernon, Ill.—The report of John J. Hainsworth, consulting engineer, of Indianapolis, Ind., in relation to the transfer of the water works and electric light properties from private to public ownership, was adopted March 15 and the plants were formally transferred to the city.

Topeka, Kas.—The city council instructed the city attorney March 14 to draw up the necessary ordinances to enable the city to acquire the water works system through condemnation proceedings. The city proposes to purchase the plant, which is now owned by a private corporation.

Portage, Wis.—The Portage City Water Works company has submitted a proposition to this city to sell and transfer to the city the water plant complete, including the company's franchise, for $42,500. A special election will probably be held in April to allow the citizens to vote on the proposition.

Flushing, (L. I.), N. Y.—Leonard C. C. L. Smith, engineer in charge of the Queens Borough water department, urges the consolidation of the three water systems of Flushing, Whitestone and College Point, the principal reason for the connection of the three systems being that while there is a deficiency in the Flushing and Whitestone systems there is a surplus in the College Point system.

Boston, Mass.—The water in the reservoir controlled by the Metropolitan water board was so low up to the early part of March

that the board warned the citizens of this city and vicinity to guard against waste. For January and February, 1901, the flow of the Sudbury river was one-quarter the average flow, and but little more than one-half the lowest flow for the same period during the last twenty years.

Keokuk, Ia.—(Special.)—J. Ross Robertson, cy. engr., says that at the regular meeting of the city council March 4 the mayor appointed two appraisers on behalf of the city to act with two to be appointed by the water works company, who, together, would appoint a fifth person, to appraise the Keokuk water works with a view to purchasing the same. The appraisers appointed by the city were Maj. M. Meigs and the Hon. John H. Cole, both of this city.

Rock Island, Ill.—The city health department located March 18 what they believe to be the main cause of the infection of city water with typhoid fever germs, and ordered the immediate shutting off of the supply at all public schools. Large cracks in the masonry of the well at the water works, into which the water supply of the entire city flows as it is pumped in through the intake pipe, were discovered, through which the seepage from the slough has been leaking.

Cincinnati, O.—The commissioners of water works are preparing to begin legal proceedings against the Lane & Bodley company for the recovery of damages because of the failure of the company to carry out its construction of the pumping machinery for the eastern pumping station. damages for the difference between the amount of the Lane & Bodley contract and the amount of the proposal of the Camden Iron works, to which the contract was let in February, amounting to over $300,000. will be claimed.

Laurel, Md.—In a test case brought before the court of appeals to test the legality of the wording of a section of a bill passed by the Maryland legislature Judge Briscoe established the legality of the bill. The bill was entitled "an act to authorize the mayor and city council to issue," etc., omitting the words "of Laurel." The firm will be notified of Judge Briscoe's decision, and should it refuse to accept the bonds it will forfeit its own bond, and the second bidder will be notified.

Ogden, Utah.—The Bear River Irrigation and Ogden Water Works company has been reorganized and incorporated under the laws of Oregon. The Ogden City Water Works company passed into the hands of the newly organized company March 19. The company now proposes to enforce the payment of water rentals, in opposition to a resolution passed by the city council warning consumers against such payment. When the resolution was passed an injunction was threatened to prevent the company from shutting off water of consumers who had failed to pay their rental. If such an injunction is sought now it will be taken to the federal court instead of the district court, as heretofore. In the various litigations over the ownership of the system the federal court has been favorable to the city, while the state courts have favored the city, it is alleged.

CONTEMPLATED WORK.

Telluride, Col.—An increased water supply is needed.

Arcola, Ill—The establishment of a water system is proposed.

Oneida, N. Y.—The question of a water supply will be voted on again.

Louisville, Ky.—A filtration plant at Lakeland asylum has been decided upon.

Atlanta, Ga.—The question of issuing $200,000 bonds was favorably voted on March 20.

New Albany, Ind.—Extensive improvements are contemplated by the New Albany Water Works company.

Wells, Minn.—Another reservoir and new pump for the water works system are needed.

St. Cloud, Minn.—Filtration of the city water supply is contemplated, according to press reports.

Martinsburg, W. Va.—The improvement of the water works plan is proposed. A. F. Lambert, cy. clk.

Pontiac, Mich.—The expenditure of $50,000 for water works extension and improvements will be voted on in April.

Kokomo, Ind.—The city council has authorized its water committee to ask for bids for a municipal water plant.

Jasper, Minn.—An engineer will probably be employed to make plans and specifications for a water works system.

Hopkinton, Ia.—Bids will probably be received the latter part of April for building water works. F. C. Reeve, clk.

Evansville, Ind.—Mechanical filtration is recommended by the water works trustees at a cost of $300,000.

Paoli, Ind.—Experiments are being made by the city council with a view to securing a better water supply.

Austin, Tex.—Bids for an engine to operate the 6,000,000 gal. pump now in use will be received by Supt. Patterson.

Itasca, Tex.—The purchase of a 72,000-gal. compound duplex pump is proposed for the water works. James W. Hackaday.

Kahoka, Mo.—Plans and estimates for a water works system will be made by George C. Morgan of Chicago. J. T. Laughlin, cy. clk.

Ft. Atkinson, Wis.—Plans for a water works system for this city have been prepared by C. F. Loweth, C. E., of St. Paul, Minn.

Tell City, Ind.—(Special.)—H. J. Stuehrk, cy. clk., says that plans for water works are now being prepared by John J. Hainsworth of Indianapolis.

Woodbury, N. J.—The council will readvertise for bids for pumping machinery for the water plant according to press reports.

Chrisman, Ill.—The citizens are in favor of granting a franchise for constructing water works. J. M. Wasson, twp. clk.

Kirkwood, Mo.—The question of granting a franchise to Guy A. Jurden for erecting a water plant will be voted on April 2.

Brockton, Mass.—Charles R. Felton, cy. engr., has been authorized to employ a consulting engineer regarding a water supply.

The question of issuing water works bonds has been favorably voted on at the following places: Dublin, Ga.; Copenhagen, N. Y.; Voorheesville, N. Y.

Philadelphia, Pa.—New bids will probably

be asked soon for the filter plant for Lower Roxborough. The recent bids were rejected owing to a court decision.

The extension of the water mains is contemplated as follows: Hartford, Conn., 9,500 ft.; Jackson, Mich.; Granite Falls, Minn.; Bloomington, Neb.; Hayfield, Minn.

Glenwood Springs, Col.—The question of issuing $80,000 bonds for municipal ownership of the water works and electric light plant will be voted on this spring.

Ft. Collins, Col.—The city council committee has reported in favor of extending the main supply pipe to a point above this city; estimated cost, $185,000.

Worcester, Mass.—The water committee has voted to ask for $150,000 of which $100,000 is for the completion of the Holden reservoir and $50,000 for pipe laying.

Iroquois, Ont.—The question of issuing $20,000 bonds for the purchase and extension of the present water works system will be voted on April 9. Allen McQuinn, cy. clk.

Grand Rapids, Wis.—The question of issuing bonds for $60,000 for the purchase of the water works system and for extending the system to the East Side will be voted on April 12.

Syracuse, N. Y.—The extension of water mains in the village of Elmwood, recently annexed to the city, is contemplated. John H. Moffett, supt. bureau of sts., Syracuse.

Jamestown, N. Y.—J. F. Witmer, C. E., of Buffalo, who is making plans for a municiual water plant for this city, has decided upon Clifton, near Chautauqua Lake, for a source of water supply.

Lynchburg, Va.—The water committee has voted to expend $1,000 in an investigation of proposed plans for a pure water supply. City Engineer DeMott recommends the employment of an expert engineer.

Franklin, Pa.—(Special.)—The water works system, or a part interest in it, is offered for sale to a party who will greatly improve it. If not sold the works will be improved by sinking an immense well 50 feet in diameter and 35 feet deep. John Haupt.

Philadelphia, Pa.—The introduction of water meters in all premises where the owners desire them is favored by the council's water committee. An ordinance has been recommended which provides for laying water conduits and pipes from Lardner's Point to the Wentz farm reservoir.

The question of issuing bonds for the building of water works will be voted on at the following places: Gastonia, N. C., May 6; Roanoke, Ala., April 10; Elk Point, S. D., Elm Valley, Minn., Cumberland, Ia., Cadott, Wis., April 2; Mackinaw, Ill., Woodbine, Ia., Brookings, S. D., Excelsior, Minn., Sioux Falls, S. D., April; Riceville, Ia.

Phoenix City, Ala.—(Special.)—W. D Wilkins, mayor, has been authorized by the legislature to sell bonds to the amount of $25,000 for the construction of a water works in said town. The mayor and board have engaged Alber & Byrne, consulting engineers of Birmingham, Ala., to prepare the plans and specifications, and superintend the construction of the same.

Kansas City, Mo.—The proposed improvements to the water works are as follows: Installing two 300 horse power boilers at Quindaro pumping station; building line from Twelfth and Bell to Kaw Point; purchase and erection at Quindaro of one, with privilege of two, 10,000,000 triple expansion engines; construction of certain 8, 10 and 12-inch lines in business portion of city; construction of 30-inch high grade pressure lines, Kaw Point to Quindaro, and all necessary work to divide city into low and high service districts. Supt. Longwell.

The construction of water works systems is contemplated at the following cities and towns: Topsham, Me.; Marseilles, Ill.; Park River, N. D.; Essexville, Mich.; River Rouge, Mich.; Lewisburg, Tenn.; Schoharie, N. Y.; Sheridan, Mo.; Carbondale, Pa.; Dexter, Me.; Parish, N. Y.; Ft. Morgan, Col.; Napoleonville, La.; Harpersville, N. Y.; Smithville Flats, N. Y.; Kirkwood, S. C.; Ellisville, Miss.; Murfreesboro, Tenn.; Winchester, Tenn.; Princeton, Ky.; Augusta, Mich.; Vermontville, Mich.; Excelsior, Minn.; Tell City, Ind.; Kimballton, Ia.; Wilton, Wis.; DeGraff, Minn.; Woodstock, Minn.; Lamont, Ia.; Wethersfield, Conn.; Motley, Minn.; Henry, Ill.; Sheffield, Ala.; Gadsden, Ala.; Graettinger, Ia.; Gloster, Minn.

CONTRACTS TO BE LET.

Lewiston, Minn.—Bids will be received April 15 for building a water works system. Chas. Posz, vil. clk.

Ocean City, Md.—Bids will be received until April 3 for building a water works system. John L. Streeper, cy. clk.

Fonda, N. Y.—Sealed bids are asked until April 8 for building a water works system for the Fonda Water Works company, A. H. Burtch, pres.

Everett, Mass.—Bids are asked until April 3 for 1,177 lengths of 6 to 12-in. cast iron pipe; 85, 6x6 to 12x10, tees, etc. M. McNamara, chmn. B. P. W.

Ft. Wayne, Ind.—Sealed bids are asked until April 23 for an air-lift pumping plant to supply this city with water. P. J. McDonald, clk. B. P. W.

Pittsfield, Mass.—Bids are asked until April 2 for furnishing 100 tons of 4 to 10.-in. cast iron water pipe. J. S. Bacon, chmn. of bd.

Indianapolis, Ind.—Bids are asked until April 10 for furnishing and erecting a triple-expansion pumping engine, etc. Thomas A. Morris, pres't.

Cincinnati, O.—Sealed bids are asked until April 3 for furnishing and delivering water pipe, water pipe specials and loam castings. Robert Allison, pres. B. P. S.

Lexington, Ky.—Bids are asked until May 14, by the Lexington Hydraulic and Manufacturing company, for constructing an earthen dam about 3 miles from this city. S. A. Charles, supt.

Baltimore, Md.—Bids are asked until April 3 for furnishing and delivering such water meters as may be required by the water company during the remainder of the year 1901. A. M. Quick, water engr.

Yonkers, N. Y.—Bids are asked until April 8 for furnishing 1,100 lengths of 4, 6 and 8-inch cast iron water pipe and for erecting a boiler at the low service pumping station. J. C. Shotts, pres. bd. water comm's.

Kenosha, Wis.—Sealed bids are asked until April 2 for furnishing and erecting one vertical cross-compound pumping engine of 4,000,000 gallons capacity in 24 hrs., together with other receiving pipe and accessories. R. H. Moth, supt. W. W.

Cleveland, O.—Bids are asked until April 3 for furnishing and delivering 50 ft. of 30-inch riveted steel water pipe, 984 ft. of 33-inch riveted steel water pipe, including one 33x30-inch reducer and curve, and one 33-inch curve. Walter P. Rice, dir. pub. wks.

Silver Creek, N. Y.—(Special.)—The S. Howes company invites bids for the supply of a steam power plant of 100 I. H. P. Corliss type engine, and Cahill type upright water tube boiler preferred; induced or forced draft. The bids should be addressed to the company's engineer, M. I. Barbeau.

Cincinnati, O.—Sealed bids are asked until June 18 for erecting three self-contained vertical triple-expansion pumping engines of 25,000,000 gals. capacity each, three of 12,000,000 gals. capacity each, one 30-ton electrical crane, and necessary boilers. Aug. Hermann, pres't bd. of trustees, W. W. comm's.

CONTRACTS AWARDED.

Trenton, N. J.—The contract for a 15,000,000-gal. pump has been awarded to the Barr Pumping Engine company for $56,500.

Detroit, Mich.—The contract for a 60-in. sluice gate was awarded, March 13, to the Russell Wheel & Foundry company, for $1,045.

Spokane, Wash.—The contract for laying water mains on Augusta-ave., between Atlantic and Calispell, was awarded to Ethan Allen.

Ottumwa, Ia.—The contract for building a new water works system was awarded, March 18, to the Fruin-Bambrick Construction company of St. Louis, Mo., for $400,000.

Beaver Falls, Pa.—The contract for constructing a filtering cribb in the Allegheny river at Wildwood, to furnish water to Wilkinsburg, North Braddock, Rankin, Swissvale and part of Brushton, was awarded to Campbell & Sons of this city for $53,500.

Louisville, Ky.—Bids were opened, March 9, by the Louisville Water company for the new filters and contracts awarded as follows: U. S. Cast Iron & Pipe Foundry company, Louisville, straight bell-and-spigot pipe, $25 per net ton for full lengths and $35 for fractional lengths; full-length flanged pipe, $45 per ton plus ¾ ct. per pound for facing and drilling; special castings, 4¼ cts per pound for loam, 2½ cts. for others, and 1 ct. per pound for facing and drilling flanged specials. Warren City Boiler Works, Warren, O., three filter tanks, $22,825; standpipe and alumina tanks, $20,195; gate valves, Ahrens & Ott Mfg. Co., Louisville, $11,030 (provisional award). Vulcan Iron Works, Chicago, balanced gate valves, $1,994. Granger & Co., Louisville, electric crane, $32,500; agitator, $16,700. National Foundry and Machine company, Louisville, galleries, stairs, etc., $1,498 (provisional award). Geiger, Fiske & Koop, Louisville, elevator, $2,150. Jos. McWilliams & Co., Louisville, heating plant, $8,533. Two small contracts have not been awarded yet.

BRIDGES.

Medway, Me.—A bridge is proposed across the East branch.

Ashland, Kas.—A bridge across the Kansas river is proposed.

Bayville, N. Y.—A new bridge to replace the old structure is proposed by the town.

Bay City, Tex.—The question of issuing $40,000 bonds for bridging the Colorado river will be voted on April 2. Co. coms.

Topeka, Kas.—The county commissioners have decided to build a bridge across the Kansas river from Fairchild-st.

Boise, Idaho—Bids are asked until April 15 for a steel bridge across Boise river. W. M. Clark, chm. bd. co. coms.

Muscatine, Ia.—Bids are asked until April 3 for all iron bridges to be built during the ensuing year. A. C. Noble, co. audt.

Mittineague, Mass.—Sealed bids are asked until May 1 for building a two-space deck bridge over Westfield river. Co. coms.

Watertown, Conn.—A petition is being circulated asking for a bridge across the Naugatuck river, from this city to Waterville.

Milwaukee, Wis.—Sealed bids are asked until April 20 for building a highway bridge across the Milwaukee river at Grand-ave. Chas. J. Poetsch, chmn. B. P. W.

St. Joseph, Mich.—The question of issuing bonds for the construction of the Michigan-ave. viaduct will be voted on April 1. C. S. Rigby, cy. engr.

Chicago, Ill.—Sealed bids are asked until May 8 for constructing the substructure and superstruction of a bridge across the Chicago river. Alex. J. Jones, prest. bd. trustees.

Lampasas, Tex.—Plans, specifications and estimates will be received until April 16 for two iron or steel bridges to cross Colorado river, between Lampasas and San Saba counties.

Lynchburg, Tenn.—The question of building a new steel or stone bridge to replace the present structure across East Mulberry creek will be considered at the April term of court.

Lancaster, Pa.—Bids are asked until April 4 for building a stone arch bridge in Euphrata twp., and two wrought iron and steel bridges. Daniel E. Mayer, chmn. co. coms.

Niles, O.—The construction of a girder bridge over Mosquito creek is contemplated by the county commissioners, the city council and the Mahoning Valley and Trumbull Electric railways.

Indianapolis, Ind.—Plans have been contemplated for two new bridges across White river at W. Washington-st. and River-ave. B. J. T. Jeup, cy. engr., estimates the cost of Melan arch bridges at $125,000 each.

Lancaster, Pa.—Bids are asked until April 4 for building a stone arch bridge in Euphrata twp., a wrought iron and steel bridge across the Cocalico creek, a wrought iron and steel bridge of 85-ft. span and 16 ft. W. Long, co. com.

STREET LIGHTING.

Sabetha, Kas.—A municipal light plant is proposed.

Nashville, Tenn.—Bids will be asked soon for the proposed new electric light plant.

Independence, Mo.—The question of electric lights will be voted on April 30.

Westerly, R. I.—Municipal ownership of the gas and electric lighting plants is desired.

Frenchtown, N. J.—Bids will be received

May 1 for constructing an electric light plant. John Hyde, jr.

Burlington, Ia.—Bids are asked until June 1 for lighting the streets for five and ten years. Frank P. Prugh, cy. clk.

Wilmington, N. C.—Bids are asked until April 10 for lighting the city with electricity for one year. A. M. Waddell, mayor.

Richmond, Va.—Bids are asked until May 1 for furnishing 560 arc lights for one year. W. P. Knowles, supt. City Gas Works.

Tipton, Ind.—The city council is making arrangements for installing a new municipal light plant.

New London, Iowa.—The question of changing the street lighting system to electric lighting is being agitated.

Kenosha, Wis—The Citizens' Electric company is being organized here to compete for the lighting of the city.

Aurora, Nebr.—The question of purchasing the present electric light plant or building a new one will be voted on.

Lincoln, Nebr.—The question of issuing bonds for building an electric light plant will be voted on April 2. H. J. Winnett, mayor.

Elmwood, Ill.—A contract for arc lighting has been awarded to the Elmwood Electric Light company, at $4 per month, per light, for five years.

Glenwood Springs, Col.—An ordinance providing for municipal ownership of the electric light and power plant will be voted on April 2.

Albany, N. Y.—The contract for lighting the city with electric arc lamps for five years was awarded March 15 to the Municipal Gas company at 32 cents per lamp per night.

Tacoma, Wash.—The contract for furnishing the city with 150 electric light meters was awarded to the Electric Light Appliance company of Chicago at $10.65 per meter.

Little Rock, Ark.—An ordinance has been passed appropriating $16,000 for the enlargement of the city electric light plant. W. R. Duley, mayor.

St. Joseph, Mich.—This city voted March 4 to bond for $12,000 for establishing a municipal electric light plant to furnish 120 arc lamps for illuminating the streets.

Watkins, N. Y.—A contract for lighting the streets for five years was awarded March 3 to the Watkins Electric Light and Power company at $60 per year, per arc light, and $15 for incandescent lights.

Annapolis, Md.—The Anne Arundel county commissioners awarded a contract March 12 to the United Electric Light and Power company for lighting Brooklyn and Curtis Bay with 32 arc lights of 500 c. p.; to be increased to 60 lamps for $3,000 a year.

Clinton, Ia.—Bids will be asked in April for rebuilding and improving the electric light plant recently purchased by the cty. S. M. Highlands, pres. Clinton Gas Light and Coke company.

The construction of electric light plants is contemplated at the following places: Scribner, Neb.; Conrad, N. H.; Cove, Or.; Plainfield, Ill.; Oxnard, Cal.; Algood, Tenn.; Bolivar, Mo.; Statesboro, Ga.; Poland, N. Y.; Springville, Utah: Butler, Mo.; Trenton, Mich.; Wapella, Ill.; Carver, Minn.; Nashua, N. H.; Emporium, Pa.; Tifton, Ga.; Iuka, Miss.; Dresden, O.; Manton, Mich.

Washington, D. C.—E. M. Dawson, ch. clk. of the department of the interior, is preparing to ask bids for establishing an electric light plant for lighting the patent office building, the old postoffice department, the bureau of Indian affairs and the pension building.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Sault Ste. Marie, Mich.—A method of garbage disposal is proposed.

Dayton, O.—The B. C. A. has about decided to rebuild the crematory. Pres. Herbig.

Erie, Pa.—The joint street committee has asked for appropriation of $8,000 for street cleaning for the year.

Sacramento, Cal.—The clerk of the board of trustees has been instructed to ask for bids for four sprinkling wagons.

Atlanta, Ga.—Bids will be asked at once for collection and disposing of the garbage for one year. Bd. of health.

Spartansburg, S C.—(Special)—F. H. Knox, engr., says the purchase of one street sweeper and one street sprinkling wagon is proposed.

Chicopee, Mass.—Bids are asked until April 10 for the collection of garbage for the year ending May 1, 1902. Rich. D. DeWitt, sec'y bd. health.

Philadelphia, Pa.—Contracts for sprinkling the park drives have been awarded as follows: East Park drive, Wm. D. Miller, $5,630; West Park drive, John Lynch, $7,443, and Wissahickon drive, $1,860.

Indianapolis, Ind.—The contract for sprinkling was awarded March 25 to C. Rust and F. Kennington & Co., as follows: Twice a day, $20.60 for each 10,000 sq. ft.; three times a day, $21.60 for each 10,000 ft. The contract applies to the whole city.

St. Paul, Minn.—The contract for sprinkling districts 4 and 14 have been awarded to Fielding & Shepley, at 15½ and 32½ cents per 100 feet per week, respectively. James Forrestal secured the contract for sprinkling districts, 1, 2, 3, 5, 6, 7 and 8 at 14.67 cents to 16.48 cents per 1,000 feet per week.

Detroit, Mich.—Bids were received Mar. 11 for garbage collection and disposal for terms of 3, 5, 7, and 10 years. The bids were on the basis of collection alone, disposal alone, and the two combined. James Hanley was the lowest bidder on collection, at $31,000 a year, for either three or five years, $31,775 for either 7 or 10 years. James A. Mercier was the lowest bidder for disposal at $20,000, $19,000, $18,000 and $17,000 per year for the several terms, shortest to longest period. For both collection and disposal the lowest bids were as follows: 3, 5 and 7-year periods, respectively, $50,000, $52,000 and $54,000, from J. A. Mercier; for ten years, $55,000, from the Detroit Sanitary company, which now has the contract for disposal by the reduction process. Mr. Hawley's bid for collection, at $31,775 per year, and Mr. Mercier's for disposal at $17,000 per year, making a total of $48,775 per year, would be the cheapest.